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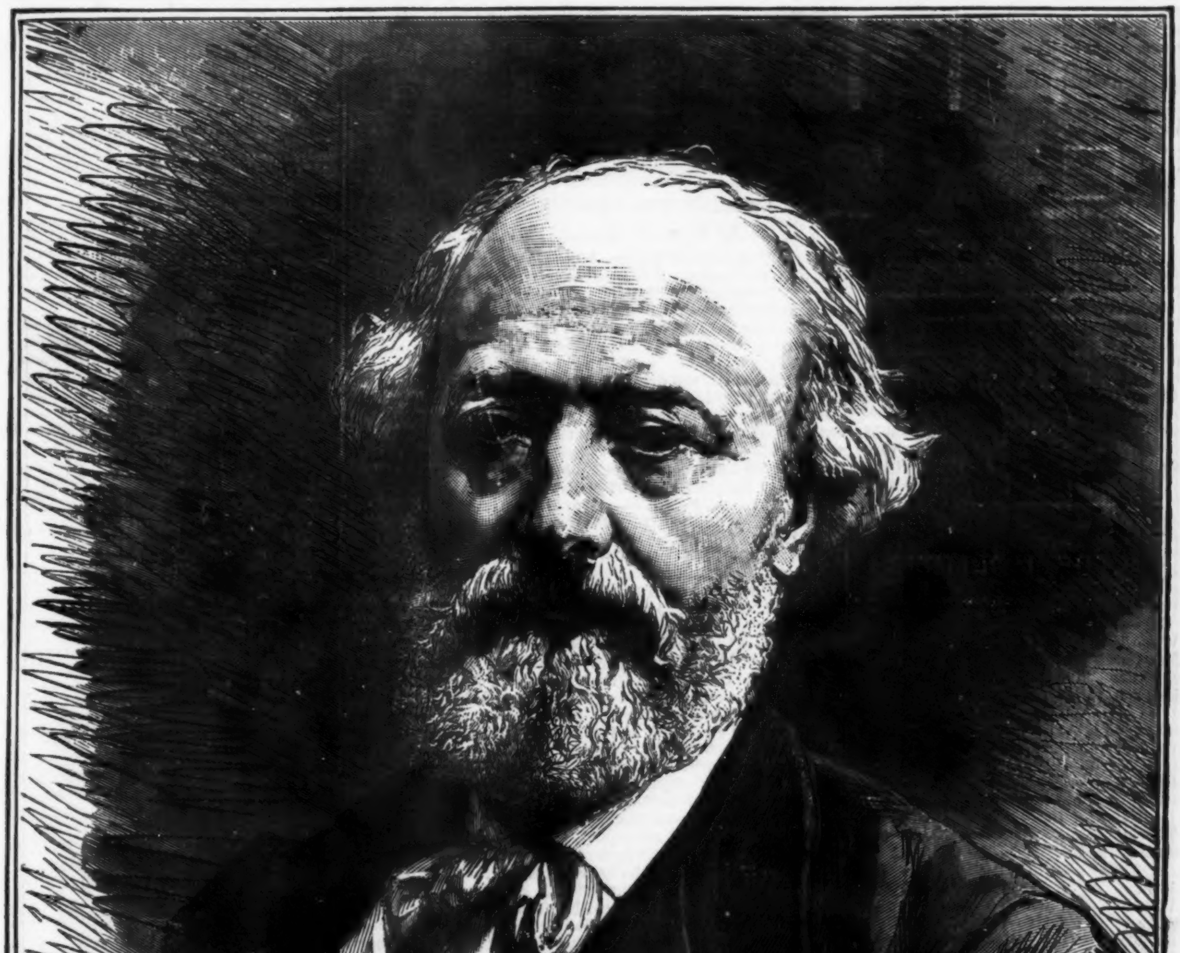
M. VIOLLET-LE-DUC.

By the death of Viollet-le-Duc, France has lost one of her most famous sons. It would be difficult to mention an artist whose reputation was wider, at least the name of no other French architect was so familiar throughout Europe and America. The circumstances of his life may be narrated within a limited space. Eugene Emmanuel Viollet-le-Duc was born at Paris in 1814. He began his studies in a private institution at Fontenay-aux-Roses, and finished them at the College Bourbon. At an early period of his life he manifested a decided taste for architecture, and therefore after his graduation he entered the office of M. Achille Leclère, where he made a study of Gothic and Renaissance architecture. Following the usual practice of French students, he traveled in Italy and Sicily, studying the Greek and Roman monuments of art. Returning to France, he visited the principal cities of the South, devoting himself to the architecture of that part of the country. He gained a reputation for accurate knowledge of Gothic work, and was in consequence intrusted by the commission having charge of historical monuments with the restoration of Vezelay Abbey. After several other important labors he was given charge of the restoration of the church of Poissy, the fortifications of Carcasonne, etc.

In 1845 he was appointed, in conjunction with his friend Lassus, architect for the restoration of Notre Dame, and the construction of a new vestry—an elegant annex, conceived in the style of the 14th century. The latter construction is so well adapted to the apse of the cathedral that it in no wise injures the old cathedral, but, on the contrary, looks as if it had always formed a part of it. In 1847, M. Viollet-le-Duc was appointed architect of the Abbey of Saint Denis by the Chapter, and in 1853 inspector general in the diocesan service. In the latter capacity he restored Notre Dame of Châlons-sur-Marne, and the Cathedral of Laon. He was fortunate in securing the favor of the Emperor Napoleon III., and in consequence obtained a commission for the restoration of the Castle of Pierrefonds. It may be said of him that he was more concerned in restoration than any of his contemporaries, but it cannot be allowed that he was always successful. He had a fondness for theory, and a society for the preservation of ancient buildings, if such a body could exist in France, would easily discover many instances where much was sacrificed to it. Restoration he considered to mean making new, and the best course for the restorer to adopt would be to imagine that the original architect had come to life again, and then to deal with the building as it might be imagined he would deal with it, having in view modern requirements. The theory is ingenious, but it is not safe. M. Viollet-le-Duc was nominated to a professorship at the Ecole des Beaux Arts, but he was too determined an opponent of academic classicism and of official routine in teaching, to be agreeable to the authorities of the school, and the lectures he had prepared were never delivered. His work as an architect might be supposed to be sufficient to engross the whole time of any ordinary man. He was a master of system, and possessing a genius for the dispatch of business, he allowed a certain number of hours every day to architectural affairs, and the remaining time was devoted to literature. The quantity of book writing and illustrating he was able to produce is surprising. His "Dictionnaire" was by itself enough to establish his reputation as an archæologist and a draughtsman. Then there were his "Mobilier Français," his book on Mediæval Military Architecture, his lectures, besides popular treatises on architecture and contributions to contemporary literature. How well he could turn spare moments to account is shown by his "Histoire d'une Maison," which was



M. VIOLLET-LE-DUC, THE GREAT FRENCH ARCHITECT.

composed and illustrated during the evenings of two months when he was employed in preparing a map of the French Alps. Another proof of his versatility and industry was seen in the skill he acquired as a military engineer. In this branch of applied science he was a recognized authority, and it may not be out of place to notice here that he was frequently consulted by the late Emperor respecting the permanent defenses of the country. Had his recommendations been carried out the investment of Paris would have been rendered impossible, while the progress of the German invasion elsewhere would have been attended with greater difficulties. As colonel of engineers no officer displayed greater skill, energy, or bravery in the defense of the city; and every operation planned and directed by him during the siege was successful. Within two or three days after the signing of the armistice the Germans had done their utmost to destroy all evidences of their works of investment. Nothing, however, had escaped the vigilant eye of M. Viollet-le-Duc. In that brief space of time he had surveyed and accurately noted all these works of investment, plans and descriptions of which are given in his interesting memoir of the siege. Upon the outbreak of the Commune he was solicited by its chiefs to take the military command, and had he not made a timely escape, would probably have paid the penalty of his life for refusing that questionable honor. From his retreat at Pierrefonds he was recalled by General MacMahon to assist the Versailles troops in re-entering Paris. It is deserving of mention that in his absence a devoted band of craftsmen thrice gallantly defended his house from being burnt and pillaged.

Latterly, in addition to architecture, archæology, and literature, he was concerned in municipal affairs, and there seemed to be several years of energetic work before him; but his most useful career came to an end suddenly on the 17th of September, 1879, at his charming place on the banks of Lake Geneva, through an attack of apoplexy.

VIOLLET-LE-DUC.

THE French papers* all speak in highly eulogistic terms of M. Viollet-le-Duc, and of the great loss sustained in his death. From them we glean additional information of his education and works. His father was "Conservateur des Bâtiments Royaux" (Keeper of the Royal Palaces), and lived in the Palace of the Tuileries, where the son, therefore, passed the days of his youth; he (M. Viollet-le-Duc) was always fond of drawing, and used to amuse the King (Charles X.) by drawing portraits of the various officials about the court. He began his travels very early in life, and made pedestrian tours through various portions of France, measuring and drawing all the Mediæval remains he came across, and which up to that time were despised or ignored by architectural students. When in want of money he returned to Paris, and either by the sale of water-color drawings or by the preparation of designs for the decorator Ciceri, gained sufficient resources to enable him to start again. In 1836 M. Le Duc left France for Italy in company with Monsieur Gaucherel, the well-known engraver and etcher; he visited Rome, Naples, Sicily, and Vienna, studying more particularly the Romanesque buildings in these towns, which were not much known then, and he made in the course of his studies many interesting discoveries, ascribing to many buildings a very different date from that generally received. At Rome he made the acquaintance of Monsieur Ingres, the painter who was then the director of the Villa Medicis; he assisted him with his advice, and obtained for him special facilities for copying the wall decorations of the Vatican and the Roman Baths. When he returned to Paris in 1838 he was well prepared for every kind of work connected with the practice of his profession. The exhibition of his drawings called forth praise from the architects and connoisseurs in Paris, and commenced his reputation. As noticed in our first article a new field of study had just then been opened in France, and it was beginning to be noted that Art in France was not confined to the works of the Renaissance period. Certain archæologists, such as Merimée and Vitet, had written of the beauty of the Gothic remains, and had created an enthusiasm in favor of the picturesque works of the Middle Ages. Through these two writers, who had known M. Viollet-le-Duc from his youth, he obtained his first important work, the restoration of Vezelay. It would seem that his appointment as architect of Notre Dame was obtained through competition, whether for the design of the sacristy, the flèche, or the design for the spires for the western towers (the latter never carried out) we know not. It obtained, however, for him the first position among the Gothic revivalists. He was then thirty-one years old. The restoration of the Abbey of St. Denis, and the several cathedrals cited in our first article, together with many others of which we have not yet been able to obtain a complete list, followed at various intervals. The way in which these works were carried out is worthy of note. In all state works in France (and the restoration of the cathedrals and public buildings is always undertaken there by the state) the staff of the office is also nominated and paid by the state, and we believe in these cases the architect receives only 3 per cent. Instead, therefore, of having a large office in Paris, each of the works has its special staff, and all the drawings are made on the building. M. Viollet-le-Duc used to visit the works at certain periods, once a month or so, according to the importance of the work or the rapidity with which it was being carried out, and make his drawings on the spot, explaining them personally to the several artificers who were to carry them out. He was so well versed in all the manipulative processes that he was never at a loss to show the workmen how to carry out his design, and much of the sculptured decoration in the buildings he has restored has the trace of his own handiwork on it. His facility in drawing was most remarkable, and there must be thousands of designs for capitals and decorative mouldings drawn by him on tinted paper; the shadows indicated by a slight wash of Indian ink, and the lights suggested in Chinese white. His numerous publications and the large number of drawings with which they are illustrated, all done by himself, must in great part have been prepared during his leisure moments in the evenings of the days he spent in his visits to works in progress. We are informed that the work of "How to Build a House" was written when surveying the Maritime Alps to make a plan of them for the French Government. Having been called upon to restore the Cathedral of Lausanne, he was so much charmed with the place that he built himself a villa, and passed the summer vacations which of late he gave himself there. His vacations, however, were not idle ones, and at the time of his death he was occupied measuring Mont Blanc, on which, we believe, he had already published a small pamphlet. He was an indefatigable climber, and showed a courage in his ascent which astonished those who knew him but in his professional capacity. It is recorded on one occasion, that on leaping across a precipice his foot slipped and he fell down, retained only by the cord which bound him to his guide; the latter had been able to stand the first shock, but could not pull him up. Viollet-le-Duc, having satisfied himself of this, took out his knife and cut the cord; his fall seemed certain death; but by the most fortunate chance, he fell across a jutting piece of ice, and from this position he was hauled up an hour and a half afterwards, with the assistance of other guides. The interval had been employed in making various drawings of new phenomena he had observed in the formation of the glaciers.

It would appear that he was himself acquainted with the tendency to apoplexy from which he died, though he studiously kept it from all his friends.

His death was so sudden and unlooked for that many of his intimate friends were unable to follow his remains to the grave. It was uncertain also at first whether he would be buried in Paris or at Lausanne. A special train left Paris for Lausanne with about a hundred people—architects, delegates from the Paris Town Council (of which he was a member), his pupils, friends, and others who had been connected with him in his profession. His son and grandson were the chief mourners, and they were followed by the delegates of the Swiss Federal Council, of the Council of the Canton of Lausanne and of the Municipality, eight members of the Municipal Council of Paris, three superior officers of the French army, in recognition of his works on military architecture and his grade as colonel of engineers during the war. Messieurs de Baudot, Bœswillwald, F. Narjoux, Berard, Darcy, Gauthier, Lafollye, Laisné, Sauvageot, Trelat (director of the Central School of Architecture at Paris), all architects, and various sculptors, painters, literary men, and contractors, followed by the greater part of the inhabitants of Lausanne, who had the greatest affection for the artist who had come to live in their midst. No speeches were made over the grave, by the special desire of M. Viollet-le-Duc in his will.—*Building News.*

* *Le Moniteur Universel, La République Française, Le Bâtiment, Le Soleil, Le XIX. Siècle, Le Siècle, L'Evénement, La Lanterne, La France,* and *La Gazette des Architectes et du Bâtiment.*

LITERATURE AND COMPOSITION.

By ELIZA A. BOWEN, Paris, Ky.

IN my first trial of literary biography as affording topics for oral and written composition, I expected too much of my pupils for a beginning. I knew that, for the purpose, the subject-matter was so entertaining, so within their power of mental assimilation, that I thought the girls ought at once to write a biographical essay, simple and youthful in its language, but natural and relatively good. I first tested them with the delightful story told by Mr. Smiles of Thomas Richard, the naturalist. I gave them a magazine containing a charming account of him. They were much entertained with it. But when the composition came, the whole pith and interest of the story was taken out as I never would have deemed possible. They began it in the driest way imaginable, with: "Thomas Richard was born in the year ——, month ——;" and whatever entertaining incident they omitted, they told, as far as they could, the exact day and month on which he did everything. Besides, without intentional plagiarism, they so used the author's words, abridged and rearranged, that I sent their work back to them filled with quotation marks.

I made several experiments of this kind, in which the work invariably came to me a mere rehash of the author's words, with the subject wholly undigested. I saw this would never do, and in order so to manage them that they could not use the words of another person, I determined to try giving them a lecture myself, or as I called it, "a talk." I selected for a subject the life of Lord Macaulay. I got it up with much care, and, in fact, I took great interest in it. I allowed myself every possible entertaining digression about the times which did not sacrifice the unity of the subject. I told them about Mrs. H. More and her sisters, and the old fashion of calling unmarried women "Mrs." I tried to paint the home-circle of the historian, I described Holland House, and I attempted to make a vivid impression of the success of the great history. This was less difficult as I remembered the appearance of the book in my youth, and the delight of myself and an old uncle to whom I had read it aloud. Of course I put in all the anecdotes. As I talked, I noted each topic on the blackboard, by a word. I very soon saw I was carrying my young auditors with me without exception; and of course I waxed animated.

The next day, I made some of the best talkers of the class repeat it. As the girls knew they must write on the subject, and that once done with it I would answer no question (compositions were written in the schoolroom), they listened attentively to the repetition. The compositions were by far the best they had ever brought me. The entire difference of language, the way in which each was colored by the peculiarities of the writer, while all were written in simple, natural, girlish, unconventional, *un-bookish* manner, showed that the subject was well digested. The same class afterward studied the Queen Anne authors, and I invariably began by lecture and composition on the life, following it by a study of the works. I always tried, by incident and anecdote, to depict character. "Si forte reponis Achillem sit impiger, iracundus, inexorabilis, acer." To complete the picture of Queen Anne's times, I added history lessons, in which I gave an account of the Duke and Duchess of Marlborough, of the famous Earl of Peterborough, and of Queen Anne and Prince George of Denmark, whom Charles II. said, he "Tried drunk and tried sober, and found nothing in him."

The improvement in talking was very great. Some of them who had talent, could interest with their true tales occasional visitors to our schoolroom. One girl, I. C., was distinguished for the charming grace of her narrative. Besides this it was evident in various ways that they were strongly impressed. It seemed to give them very great pleasure when any current paper or magazine contained anything in reference to the subjects of our studies.

After a good deal of practice in writing from my presentation of subjects, they seemed to understand better how to make selections for themselves from books and magazines containing biographical accounts; and when called on, they made very good essays. But their interest was always much more excited by a talk, so I usually kept up the lecture plan. The impulse given to reading was so great, and that is so important an object, I could not sacrifice it. Indeed, I think most people who become readers, are first incited by cultivated conversation.

It is of great importance that young people shall become interested in the best current literature and in the topics of interest among cultivated persons of their own times; and this, like all other subjects I have mentioned, can be made to subserve in a higher degree the important end of learning to talk and write English. Among the topics I have used in pursuing this aim was Constantinople, with the "Eastern Question." My pupils became quite excited over it, went to reading vigorously, and constantly came to me in the morning with fresh news or comments from half-a dozen different journals. I am sure they will be interested in the "Eastern Question" while they live. When they wrote on Constantinople, they drew maps and plans of the city and surrounding country, with maps of the revolting Turkish provinces. Those who could draw sketched the city and the mosque of St. Sophia.

The field I have pointed out is fairly inexhaustible. I will say, from experience, that it can be made of intense interest. It gives subjects digestible by the minds of young people, and susceptible of easy and graceful treatment. It has been of the greatest service to me in the important object of training young ladies to use the English language with ease and elegance; and it has afforded me delightful work, while it has also cultivated a taste for reading in my pupils. To those teachers who can give oral instruction—that is, who can lecture—it will be found an invaluable resource. I have given my experience in this matter with the hope that it may benefit some fellow-laborers.

Of course, I do not think compositions should be confined to biographical essays; though from their adaptation to easy and graceful writing, and the number of other purposes they serve, they may well furnish a large part of the material. But I cannot now speak of other subjects fitted to accomplish the objects I have pointed out.—*N. E. Jour. of Education.*

SCIENCE AND THE U. S. NAVY.

THE extent to which the United States Navy contributes to the advancement of the useful sciences is, the *Herald* thinks, too little appreciated by the greater number of our citizens, even if it is not entirely unknown to them.

In the important branches of astronomy, hydrography, and meteorology, the officers of the United States Navy excel. Under the superintendence of the gallant and venerable Admiral Rodgers, the Naval Observatory at Washington employs the services of such eminent scientific men as Hall, Harkness, and Eastman, with many others whose names are familiar wherever astronomical research, conducted with the highest success, is appreciated. Under the direction of Captain Patterson, the magnificent work of the United States Coast Survey, although not strictly a naval institution, is sustained in the estimation of the world by such men as Hilgard, Schott, Sigsbee, and their scientific *confrères*, the larger number of whom are naval officers. The grandeur of this undertaking cannot be over-estimated, even regarding it from a purely utilitarian standpoint. It is in itself a guarantee of safety in coast navigation, and is the basis on which will rest the necessary geodetic surveys of the whole territory of the Union.

The relation the Coast Survey bears to our commerce in a particular sense, the work of the Hydrographic Office, directed by Captain Franklin, of the Navy, bears in a general sense. The unknown depths of the sea explored by Lieutenant Sigsbee; the intricacies of navigation in distant channels; dangerous shoals in mid-ocean; wolfish rocks and treacherous reefs on the highways of trade, currents and eddies—all these are searched out and charted with a care and zeal which are unequaled in any service. Not content with hydrography and its multitudinous details, ocean meteorology also receives attention, and Lieutenant Lyons, on whose shoulders the mantle of Maury has fallen, is perfecting weather and current charts for the seas of both hemispheres, which will prove as useful to navigators as they are evidences of the scientific ability and zeal of the compiler. The labors of the officers engaged at the Nautical Almanac Office, under Professor Newcomb, also deserve recognition, for they are directed to a work which is second to no other one in importance to commerce. All this labor is performed by, in many cases, young officers of the navy. People who think Washington is a lounging place for idle gentlemen drawing pay from the navy appropriations are very much mistaken. Secretary Thompson, who now controls the department, is indisposed to have anybody under his orders unemployed, and judging by the results, scientific and otherwise, which are being attained, he finds willing and capable workers in these peacefully engaged men of war.

FIGURES AND FACTS.

WHEN Mr Richard A. Proctor was lecturing in this country, his rapid speech was the terror of reporters. We well recollect the expression of despair with which one of them dropped his pencil as the words "millions of millions of millions of millions" rolled from the lips of the lecturer, in describing the distances of fixed stars. It may well be doubted whether the human mind can really form any conception of a million. If, for instance, about that number of soldiers were drawn up in solid phalanx on a plain, could anybody tell at a glance whether there were more or less present—say to the extent of 300,000—than the million?

The tendency of all modern science is to deal with these inconceivable though not unlimited quantities. It is a trite remark that the wildest flights of imagination fall short of such facts.

In a lecture at the recent meeting of the British Association for the Advancement of Science, Prof. William Crookes, the inventor of the radiometer, gave the following extraordinary figures:

A glass bulb of 13½ centimeters diameter, with which he had been showing experiments, would hold at ordinary atmospheric pressure a quadrillion of molecules of air. He exhausted it, so as to leave only a millionth of an atmosphere in it, but that remainder was still a trillion of molecules, though nominally called a vacuum. He then sent a spark through the glass, making a hole of microscopical fineness, but sufficient to allow outside molecules to enter and destroy the vacuum. If, now, we suppose that only 100,000,000 molecules could enter this little hole every second, a very simple calculation will show that it would require more than 400,000,000 years to fill the bulb with air—a period longer than has been assigned for the duration of the sun from its formation to its probable extinction. In point of fact, however, the molecules troop through such a hole at the rate of about 300 trillions a second, so that the pressure of air within the bulb was equalized with that outside before the audience left the room.

Professor Crookes justly remarked that in these experiments we touch the borderland where matter and force merge into one another; the shadowy realm between the known and the unknown.

The radiometer has been derided as "the philosopher's

toy." But even if no other use is ever found for it, the instrument will prove of immense service by its capacity of making plain to the eye some of the most wonderful properties of matter. Our conceptions of the movements and power of molecules become clearer and more definite when we see what they actually can do. People read the statements that are made by such mathematicians as Clerk-Maxwell, to the effect that on an average every molecule of a gas has 17,700,000,000 collisions with other molecules in each second of time, and shrug their shoulders. They may not disbelieve, but they scarcely believe.

Now what the radiometer shows is, that when the number of molecules of gas in a bulb is so greatly reduced that we say we have a vacuum, these remaining particles no longer strike each other so frequently; their paths are longer; they display new powers. They bombard an obstacle in their path with surprising force. If movable, like the vanes of a radiometer, it is driven with rapidity; if stationary, heat is developed, and finally light. Not the least curious feature of their motion is, that they cannot turn a corner, or, at all events, do not in this vacuum. We regard that fact as the most convincing yet offered of the correctness of present theories of atomic motion.

There are, we believe, four separate sources from which the figures have been derived that are generally accepted as giving the size of molecules and the spaces through which they vibrate, and the estimates thus attained do not differ very greatly. Figures are no aid to our conceptions of these little bodies. To see them with a microscope, we should have to put on a power that would magnify a two-inch ball to the size of the whole earth. After fairly digesting such a statement, we may with more ease consider the estimates that have been made for the ether of space, whose particles are presumably much smaller—not even so comparable as a pinhead to the two-inch ball.

This latter subject was ably discussed some years ago in a paper by Professors Hall and Harkness of the United States Naval Observatory. They studied through the figures of a supposed resisting medium in space, as shown by the change of orbit of Encke's comet. They gave two illustrations of the rarity of this resisting medium which are worth reproducing. A man ordinarily inhales at a breath a bulk of air of about the size of a large apple. If for air he had to substitute the resisting medium of space, he would have, in order to get the same amount of material into his lungs, to breathe in at each inspiration a bulk of it equivalent to a sphere somewhere between 15 and 117 miles diameter.

Again, let us imagine two little cylinders, one of which has a diameter equal to the height of the column of mercury that the resisting medium can support, while the other has a diameter of 3-1,000ths of an inch, which is that of a human hair. Now let us suppose that both these cylinders begin to grow, and continue to increase at the same rate. Then when the first has attained the diameter of the second one (that is, as thick as a hair), the second cylinder will be somewhere between 15 times and 6,300 times the size of the earth.

There is a favorite theory that has been expounded by several experts, and seems to be somewhat plausible, so far as figures are concerned, that accounts for the gravitation of matter by supposing it a result of the impact of atoms which fill all space. A single mass of matter would be equally bombarded on all sides. But where two masses were present, each one would protect the other from the bombardment in a line of space between them. Hence they would be pushed toward each other; and the tendency to go toward each other constitutes gravity.

But, whatever mathematicians may say, it has seemed scarcely conceivable that the enormous speed of bodies falling by their gravity could be caused by the impact of small impalpable atoms. The earth, for instance, is driven along in its orbit at the rate of 9⅛ miles per second, so that if a person were standing outside of it in space, he could scarcely get a glimpse of it as it rushed by. The movement of the molecules in hydrogen gas is estimated at about a ninth part of that speed—say 70 miles per minute. But they keep up this motion in spite of some 17 thousand million collisions per second among themselves.

The experiments shown by Professor Crooke render plain what the mathematicians had previously asserted, that the speed of little particles may be enormously greater when they are thinly distributed, and do not so frequently collide with each other. Their power to give the original impulse of gravitation is not exactly demonstrated by such experiments, but it is made more conceivable.

A work that will try the skill of mathematicians for many years to come is laid out in the problems we have indicated. But when all these are solved, there lies another behind them, one of far deeper mystery. Whence came the original impulse of the atoms? Let it be conceded that once started in their dance they will and must keep on for ever. Yet the question remains, What or who started them?—*Science News.*

THINGS THAT ARE MISNAMED.

WHY should trade not have a Johnson to classify and correct the mass of inconsistencies that go to make up its nomenclature? We not only tax our brains to invent "fantastic" names for every new fabric, varied, perhaps, only by a thread or a shade from what our grandparents wore a century ago, but there are in use positive misnomers for many staple articles of merchandise. The following imperfect list, culled from sources already at hand, will give a faint idea of them:

Acid (sour), applied in chemistry to a class of bodies to which sourness is only accidental, and by no means a universal characteristic. Thus rock crystals, quartz, flint, etc., are chemical acids, though no particle of acidity belongs to them.

Blacklead does not contain a single particle of lead, being composed of carbon and iron.

Brazilian grass does not come from Brazil, or even grow there; nor is it grass at all. It consists of a palm leaf (*Thrinax argentea*), and is imported chiefly from Cuba.

Burgundy pitch is not pitch, nor is it manufactured in or exported from Burgundy. The best is a resinous substance prepared from common frankincense, and brought from Hamburg; but by far the greater quantity is a mixture of resin and palm oil.

China, as a name for porcelain, gives rise to the contradictory expressions—British china, Dutch china, Chelsea china, etc., like wooden milestones, iron milestones, brass shoe horns, iron pens, steel pens.

Cuttle bone is not bone at all, but a structure of pure chalk, once embedded loosely in the substance of certain species of cuttle fish. It is inclosed in a membranous sac within the body of the fish, and drops out when the sac is opened, but it has no connection whatever with the sac of the cuttle fish.

Galvanized iron is not galvanized. It is simply iron coated with zinc; and this is done by dipping it in a zinc bath containing muriatic acid.

German silver is not silver at all, nor was the metallic alloy called by that name invented by a German, but has been in use in China time out of mind.

Honey soap contains no honey, nor is honey in any way employed in its manufacture. It is a mixture of palm oil soap and olive oil soap, each one part, with three parts of curd soap, or yellow soap, scented.

Japan lacquer contains no lac at all, but is made from the sap of a kind of tree called *Rhus vernicifera.*

Kid gloves are not usually made from kid skins, but of lamb or sheep skins. At present many of them are made of rat skins.

Meerschaum is not petrified "sea foam," as its name implies, but is a composition of silica, magnesia, and water.

Mosaic gold has no connection with Moses or the metal gold. It is an alloy of copper and zinc, used in the ancient musivum or tessellated work.

Mother of pearl is the inner layer of several sorts of shells. It is not the mother of pearl, as its name indicates, but in some cases the matrix of the pearl.

Pen means a feather (Latin, *penna*, a wing). A steel pen is not a very choice expression.

Prussian blue does not come from Prussia, but is the precipitate of the salt of protoxide of iron with prussiate of potassa.

Salad oil is not oil for salad, but oil for cleaning sallades, *i. e.*, helmets.

Salt is not salt at all, and has long been excluded from the class of bodies denominated "salts."

Sealing wax is not wax at all, nor does it contain a single particle of wax. It is made of shellec, Venice turpentine, and cinnabar. Cinnabar gives it a deep, red color, and the turpentine renders the shellac soft and less brittle.

Sperm oil properly means "seed oil" (Latin, *sperma*, seed), from the notion that it was *spermaceti* (the sperm or melt of a whale). The sperm whale is the whale that gives the "seed oil," which is taken chiefly, but not wholly, from the head.

Whalebone is not bone at all, nor does it possess any of the properties of bone. It is a substance attached to the upper jaw of the whale, and serves to strain the water which the creature takes up in large mouthfuls.

Rhinoceros horn is not horn at all, but a kind of matted or compact hair, and is only like a horn from being a protuberance on the animal's head.—*Journal of Applied Science.*

HABITUAL CRIMINALS.

Two recent publications by an Italian author, Professor Lombroso, on "Criminals, and the Increase of Crime in Italy," contain, says the London *Times*, much interesting matter, though some of his conclusions may be questioned. Studying the physical characters of habitual criminals, the author finds frequent types like the Australian and Mongol. Among the commonest peculiarities are scarcity of hairs, smallness of cranium, sloping forehead, large jaws, cheek-bones, and frontal sinus, prognathism, abnormal attachment of ears, hair black (tufted or curly), black pupils, obliquity of eyes, etc.

Another character in which criminals resemble savages is the habit of tattooing—generally a very painful operation—and M. Lombroso supposes in the subjects of it a certain obtuseness of sensibility. The courageous acts of criminals are attributed to this physical insensibility and a certain infantine impetuosity which make them heedless of danger. Hence a frequent disproportion between the gravity of the crime and that of the motive; also the cruelty often manifested by the criminal, and the large number of suicides, especially during the first months of detention. Prominent among the mental affections of habitual criminals are vanity and irritability; they boast of their dexterity in crime, and are readily thrown into wild passion by little things. Then there is the passion for drinking and gambling, covetousness combined with boundless prodigality, love of dancing, sensuality, etc.

Criminals have a language of their own, having peculiar ideas and instincts, for which they must find new terms of expression. They multiply metaphors and onomatopœiæ, and there is a singular mutability in their expressions. Laziness is a common vice in criminals. In Sicily and Sardinia idleness and vagabondage are thought to account for crime to the extent of 65 per cent. The comparatively educated class furnishes a larger contingent to crime than the peasants. Literary and artistic knowledge often renders possible a certain refined and astute type of crime, and the new desires it awakens often lead into crime. M. Lombroso delares the schools instituted in prisons have contributed to the increase of criminality, though culture at least makes crime less ferocious. He points out, too, that criminals are often not without a religious sense, as witness the crosses and images hung round brigands' necks. Hereditary influence is affirmed to cause 26 crimes per cent. Again, habitual criminals have no remorse, and the worst are those who behave best in prisons.

Italian statistics prove that 66 men and 80 women per cent. (between 1872 and 1875) have committed crimes repeatedly. Considering deaths and the crimes not proved, he comes to the painful conclusion that the number of those who fall back into crime is nearly equal to the number of criminals who come from prison. M. Lombroso endeavors to prove, for certain developments of crime, "a physiological, atavistic point of departure in those animal instincts which, checked for a certain time by education, surroundings, fear of chastisement, burst forth ere long under the influence of special circumstances." Among the latter he indicates, first, the seasons, whose influence is so evident that one might make a criminal calendar; next, there is food; when the price of wheat rises, there is directly an increase of crimes against property, and a diminution of crimes against the person, and *vice versa.* He mentions also age, celibacy, profession, irritation, sensations, infirmities, passions, and insanity.

M. Lombroso devotes a chapter to the curing of crime. Holding that adult criminality is incurable, he advocates attacking the causes which lead to it; invites legislators to better adapt their laws to climates and races; proposes abolition of the jury, more promptness in punishment, the abolition of the royal grace applied to common crimes, the sequestration of habitual delinquents, increase of the duties on liquor, prohibition of sale of it to minors, diminution of the number of fairs, markets, fêtes, etc. He condemns the houses of correction (*riformatori*) for young people; thinks it better that the imprisoned should be taught a useful trade than to read; does not believe in the efficiency of societies which befriend liberated prisoners; is opposed to transportation, and thinks establishments for incorrigibles should be formed, also asylums for criminals acquitted on the ground of insanity.

M. Lombroso considers capital punishment is applied too rarely to be efficacious, and that if it did not exist the number of crimes would neither be increased nor diminished; but he does not counsel its abolition in Italy, because the first news of this might have a bad effect, and encourage evildoers. He approves such punishments as fasting, the douche, and flogging.

THE NEW CUNARD STEAMER GALLIA.

EVER since they inaugurated their great commercial enterprise in the year 1840 with the four steamships, Britannia, Acadia, Caledonia, and Columbia, whose equals were not then afloat, the Cunard Company have invariably been in the front rank of our great steamship companies, and their Transatlantic service has been conducted with a regularity and freedom from mishaps which speaks more strongly than anything else could do for the care and ability exercised in the management of these vessels. The Gallia, which is the last and most important addition to the magnificent fleet owned by the Cunard Company, has but recently taken her place on the Liverpool and New York route, and has already established herself as a great favorite with passengers, both on the outward and homeward voyages.

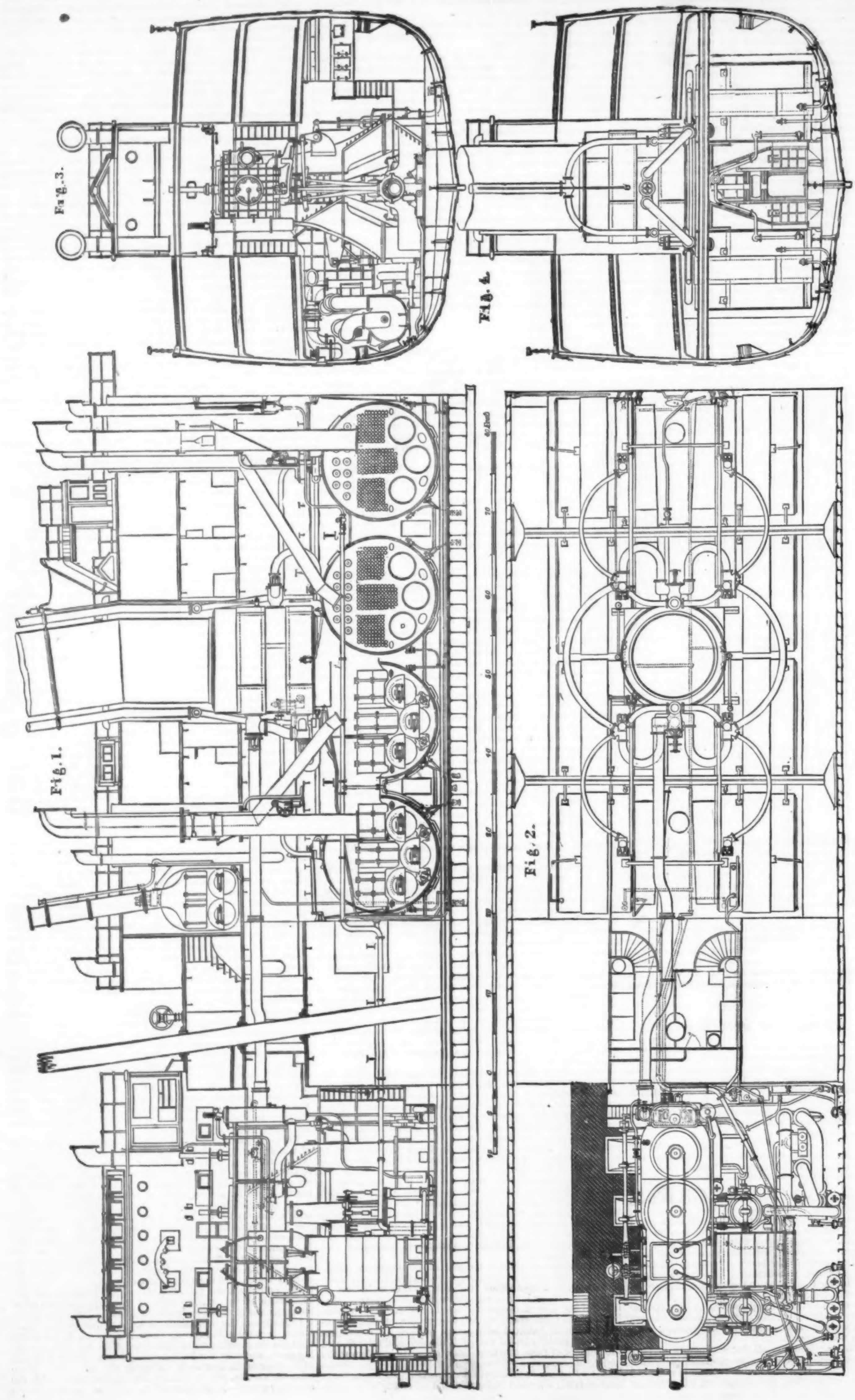
We devote a portion of our space to an illustrated description of the vessel and her machinery. Messrs. James & George Thomson, of Glasgow, the eminent firm who built and equipped the vessel, have been most intimately identified with the Cunard fleet for many years. Our illustrations comprise a perspective view of the Gallia, an engraving showing the general arrangement of the engines and boilers, and views of the engines themselves.

The Gallia is an awning-decked, or four-decked, and bark-rigged ship of the following dimensions: Length of keel, 480 ft., and over all 450 ft.: breadth of beam and depth of hold (both moulded) 44 ft. and 36 ft. respectively; and, as in all the steamers of the Cunard line, her iron and wood scantlings are generally much in excess of the official requirements of Lloyd's. Both the upper or promenade deck and the spar deck are constructed of iron throughout, while the main deck is also formed of iron for two-thirds of its length amidships; and in the lower there are the ordinary ties and stringers. The main and spar shears are double for two-thirds of the length of the ship; the promenade shear is double throughout the ship's whole length; and at the bilge there are three strakes of plating which are also double over a length of two-thirds of the vessel. All through the engine and boiler space, up to the lower deck stringer, there are deep web frames which are connected by means of heavy brackets; and owing to the weight to be borne and the great strength required, the engine seat is formed by carrying the floors of the ship up solid to the bottom of the soleplate, and is then plated from side to side of the ship with plates of ⅞ in. thick. The forward end of the ship is strengthened for panting with double-plate plating, with intercostal stringers, and with "I" beams, all of which are attached to the shell of the ship, thus forming a system of heavy breast hooks, which have been found necessary in heavy Atlantic steamers. When she was last in Liverpool, after having made several voyages, the Gallia was docked, and a careful examination of her, which was then made, most satisfactorily proved that she betrayed no signs of weakness.

As regards the disposal of the interior of the Gallia, we may mention that the spar and main decks are appropriated entirely to the accommodation of the passengers, and all the space underneath the main deck is set apart as cargo space. Her coal bunkers reach up to the main deck, and have space for stowing 1,200 tons of coal. There is an extra bunker forward which is capable of containing 500 tons of coal additional, or, if need be, it can be used for stowing cargo instead. Access is gained to this extra bunker by means of a tunnel which passes through the main forward bunker. In order that any inflammable gas that is given off by the coal may readily escape into the open air, the bunkers are provided with ventilating pipes. The main deck is taken up from end to end with the accommodation for first-class passengers, its main saloon, which is abaft of the engine space, being capable of seating about 100 persons. This saloon is lighted by means of embossed glass in the upper portions of the state-room bulkheads. The principal dining saloon, which is situated on the spar deck immediately abaft of the engine hatch, and is lighted by a large and elegant cupola, is a most spacious apartment, having sitting accommodation for about 220 passengers. Sleeping accommodation is provided for the first-class passengers, both on the main deck and on the spar deck, in the latter case abaft of the main saloon. The state rooms all through the ship are of an unusually roomy character; some of those which are forward measure about 10 ft. by 7 ft.; and partly on account of the large size of the staterooms generally, the Gallia is a special favorite with passengers to and from New York. Taking two persons per room, which is the rule in all the Cunard liners, there is accommodation on the two decks mentioned for about 320 first-class passengers; and if the staterooms generally were each apportioned to four passengers, there would be ample accommodation for nearly 500 persons. The arrangements for the ventilation of these staterooms have been most carefully considered, and so far as the main deck is concerned, the ventilation may be regarded as practically perfect; indeed, in respect of the ventilating arrangements generally, the Gallia has no equal in the Cunard fleet.

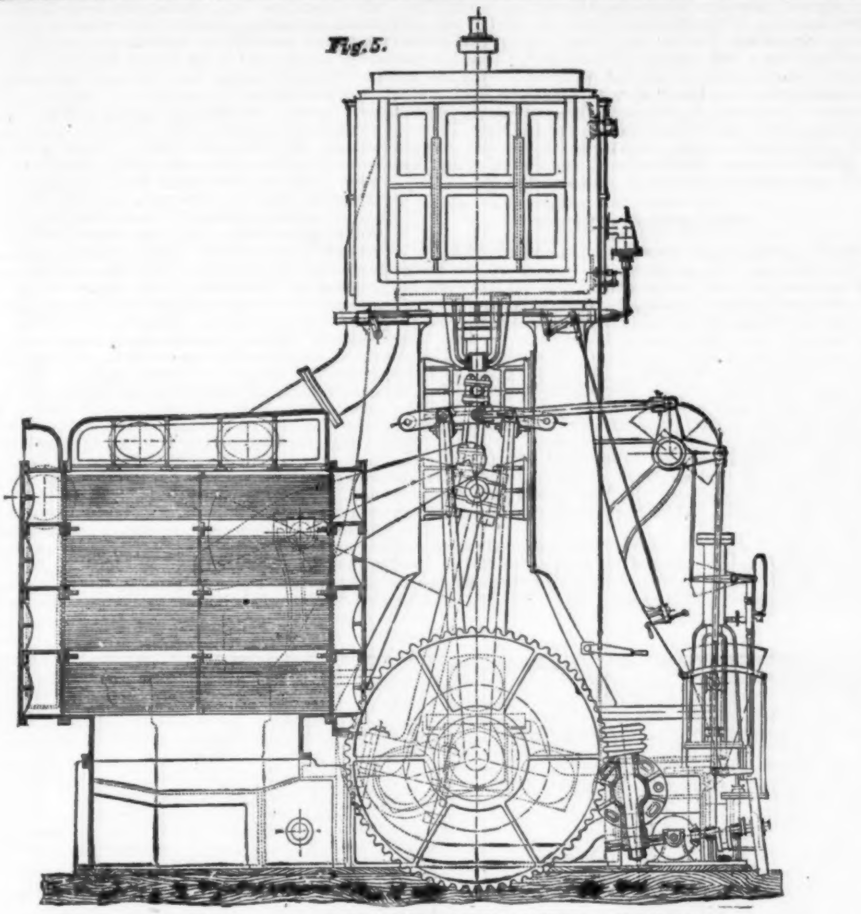
There are nine iron bulkheads throughout the ship, seven of which run up to the spar deck and are water tight, the other two being the fore and after peaks. In consequence of the adoption of this constructional arrangement, the owners of the Gallia have made her to fulfill all the Admiralty requirements for employment in war or transport service.

All the deckhouses are of iron. The midship house, which is about 100 ft. long, comprises, in the fore end, the officers' rooms, then the companion way to the spar deck, the forward air hatch, the space occupied by the steam-steering engine, and the emigrants' galley; then, around the funnel, there are the drying rooms; abaft of these there are the galley for the saloon department, another air hatch, the donkey boiler, and the after companion way. On the spar deck, underneath the galleys, there are receiving rooms provided with hoists, so that none of the food in process of being conveyed to the emigrants or to the saloon department is ever seen on the promenade deck. On this midship deckhouse, forward of the funnel, there is a small house which contains the steering wheel connected with the steam steering gear; and over it is built a flying bridge which is about 15 ft. clear of the spar deck. Passing aft we come to another deckhouse, which includes the engine hatch and the captain's rooms—in all about 37 ft. All the parts hitherto



GENERAL ARRANGEMENT OF ENGINES AND BOILERS OF THE CUNARD STEAMSHIP "GALLIA."

Fig. 5.



ENGINES OF THE CUNARD STEAMER "GALLIA."

mentioned as being embraced in the deckhouses are more or less completely indicated in the vertical section, Fig. 1. The after deckhouse, which has a total length of 60 ft., includes a large smoking room, a well to convey light and air to the main saloon on the spar deck, a deck saloon for ladies, and the companion way to the lower or main deck saloon. All these deckhouses are connected with each other by means of gangway bridges, so as to enable the captain or officer on watch to reach the standard compass on the after house without requiring to go down to the deck among the passengers. Over all there is a total length of promenade on the deckhouses of about 220 ft.; and, as is usual in the Cunard ships, the whole is surrounded with handsome protecting rails of brass.

The steam-steering engine referred to in the foregoing paragraph (Muir & Caldwell's patent) is an exceedingly ingenious and effective piece of mechanism; and one great advantage which it possesses is, that it is practically, if not even absolutely, noiseless in its operations. On another occasion we may describe it in detail.

There are three distinct lookout bridges—one on the after house, for the quartermaster stationed at the standard compass; one forward, which is supported by two iron lighthouse towers provided for the safety of the signal lights, and so devised that they may be entered from the deck below in all weathers without danger or difficulty; and the other amidships, for the use of the officer on watch.

In the after part of the vessel there is a spacious wheelhouse, which contains a powerful hand-steering gear, provided with double wheels, and so arranged that the usual screw gear can be wrought; while in the event of that giving way, arrangements are made for the use of auxiliary gear, in which purchase blocks are employed. The Gallia is thus seen to be fitted with three distinct sets of steering gear, the safety of the ship and her passengers being abundantly provided for, so far as that important feature of her mechanical arrangements is concerned.

Abreast of the receiving rooms, already referred to in connection with the spar deck, there are the pantries, sculleries, etc., appertaining to the stewards' and cooking departments, aft of which come the engineers' rooms, the officers' rooms, the doctor's room and surgery, barber's shop, etc., while forward of these there are the rooms for the quartermasters and stewards, the lavatories and water closets for the seamen and emigrants, and hospitals for the latter. Still further forward accommodation is provided for the firemen and seamen, with a steam windlass (Harfield's patent) between for working the ship's cables, which are 2$\frac{3}{16}$ in. in diameter. The anchors with which the Gallia is furnished are all of Trotman's patent, with box stocks. The bower anchors are very heavy, namely, two of 58 cwt. each, and one of 54 cwt., exclusive of the stocks.

As already mentioned, the ship is bark-rigged. All the standing rigging is of charcoal iron wire, and the overhead running gear, as usual, of hemp, and the yards fitted with Cunningham's patent reefing gear. There are ten large boats all fitted as lifeboats, and all furnished with Hill & Clark's patent lowering apparatus, so that they may be brought into service without delay in the event of an emergency arising when the ship is at sea. The fore and main lower masts are of iron, 30 in. in diameter at the deck; but there is no ironwork of any kind whatever near the mizzen mast, in order that there may be no magnetic disturbance caused to the compass which is hung upon it. We may here mention that the Gallia is furnished with eight compasses, three of which embody Sir William Thomson's patented improvements.

Directing attention now to the furnishing and decoration of the passenger accommodation of the ship, we should mention, in the first place, that the lower dining saloon, that on the main deck, is richly furnished, and decorated in white and gold; while the main saloon, on the spar deck, which is 42 ft. long and the whole width of the ship, is finished with satinwood, with redwood mouldings surrounding a series of panels executed in Japanese lacquer work, which is quite outside the beaten track of ship ornamentation. In the latter one knows not which to admire most, the richness of coloring or the variety and quaintness of the designs, which are worked out in gold on a crimson-colored ground. This most spacious apartment is also furnished with a number of large and very handsome mirrors, and with the necessary fittings for dining purposes, all of which are of the very highest excellence. The floor is laid with oak parquetry, of Belgian workmanship, and displaying much taste in design and skill in execution. In both saloons there are revolving chairs at the dining tables, which are made of maple and covered with morocco leather. The carpets used in both saloons are of Axminster make, and are alike rich in color and in design. Underneath all the tables in both saloons there is laid a system of steam pipes for heating the apartments in cold weather; and the same system of heating is also provided in the staterooms and in the steerage portion of the ship. Abaft of the upper saloon there is the ladies' boudoir, which is a most elegantly and luxuriously furnished apartment, being finished in satinwood with beautiful slabs of Mexican onyx forming the paneling, and with blue velvet covering to the seats. The ladies' deck saloon is finished in white and gold in an exceedingly chaste manner. The smoking room in the deck house is done in teakwood, with parquetry flooring, the framework of the tables being of bronzed iron, while the tops are also of onyx, which are quite a novel feature; and there is in addition a handsome onyx fountain. It should be stated that the Japanese paneling, the parquetry flooring, and the onyx paneling and table tops were all supplied by the well-known firm of Messrs. George Trollope & Sons, London. All the staterooms and saloons are brought into communication with the pantry and the stewards' quarters by means of a system of pneumatic bells; and most of the fittings in the same are finished in electro-plate.

THE MACHINERY OF THE GALLIA.

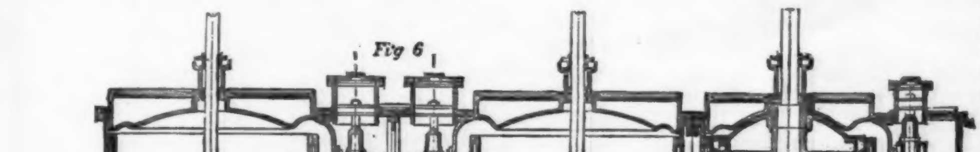
Referring more specially to the drawings with which this notice is accompanied, we may now proceed to speak of the machinery occupying the engine and boiler space, and employed in the propulsion of the ship. The engines are of the compound high and low pressure, direct acting, and three cylinder type, there being one high pressure cylinder, 63 in. in diameter, and two low pressure cylinders, each 80 in. in diameter, while the length of piston stroke is 5 ft. As will be seen from our two page engraving the high pressure cylinder stands forward, while the other two cylinders are in line with it aft. From further reference to the views on pages 200 and 201, it will be observed that the valve of the high pressure cylinder is placed on the forward end so as to admit of an arrangement for relieving the pressure on the back of the valve, and that the valves of the two low pressure cylinders are placed between these cylinders. The crankshaft is formed in two pieces—one for the high pressure engine having one crank, and the other for the low pressure engines with two cranks upon it. The journals of this shaft are 21 in. in diameter, and there are five of them, placed as shown. All the connecting rods, as indeed all the working parts of the engines, are specially arranged so as to be easily adjusted. The engines are started by the steam and hydraulic starting gear invented and patented by Messrs. Brown Brothers, Edinburgh, and shown in Fig. 5, above; and while the vessel is in port her engines are turned by a separate steam engine.

The surface condenser is of the box type; it is fitted with brass tubes and tube plates, the former being packed with glands and cotton packing. The condenser tubes are ¾ in. in diameter and 9 ft. long, and the total condensing surface is 8,300 square feet. The engines can be worked either as surface condensing or as ordinary injection engines. Water is circulated through the condenser by means of two large centrifugal pumps of Messrs. John & Henry Gwynne's make. One of them is quite sufficient to work the engines while going at full power, and the object of having two is to provide against any accident arising. There are in connection with the engines two air pumps, three feed pumps, and two bilge pumps, besides which there are provided two large donkeys as auxiliaries in case of need.

The propeller has a boss with movable blades—the former being made of iron, and over 10 tons weight, while the blades are made of steel, and were cast by Messrs. John Brown & Co., Sheffield. In all, the propeller weighs about 24 tons. Dunlop's pneumatic governor, as described at the meeting of the Institution of Mechanical Engineers recently held in Glasgow, and as illustrated by us on page 187 of our eighteenth volume, is adopted in the Gallia.

Steam is supplied to the engines by eight cylindrical boilers, 14 ft. 6 in. in diameter, and 9 ft. 6 in. long. As

Fig 6



ENGINES OF THE CUNARD STEAMER "GALLIA."

seen in Fig. 1, each boiler is fitted with three furnaces, so that in all there are 24 furnaces, the total firegrate surface of which is 588 square feet. The boiler tubes are 3⅛ in. in diameter by 7 ft. long, and the total heating surface in the eight boilers is 18,000 square feet, while (as will be seen from our two page engraving) there is a superheater surrounding the base of the chimney and exposing 400 square feet of surface. The working pressure is 75 lb. per square inch. In addition to the main boiler there is also, as shown by our two page engraving, an auxiliary boiler placed at a higher level and available for working the donkey pumps or fire engines. This boiler is 8 ft. wide, 8 ft. long, and 10 ft. high, and has three furnaces 2 ft. 6 in. in diameter.

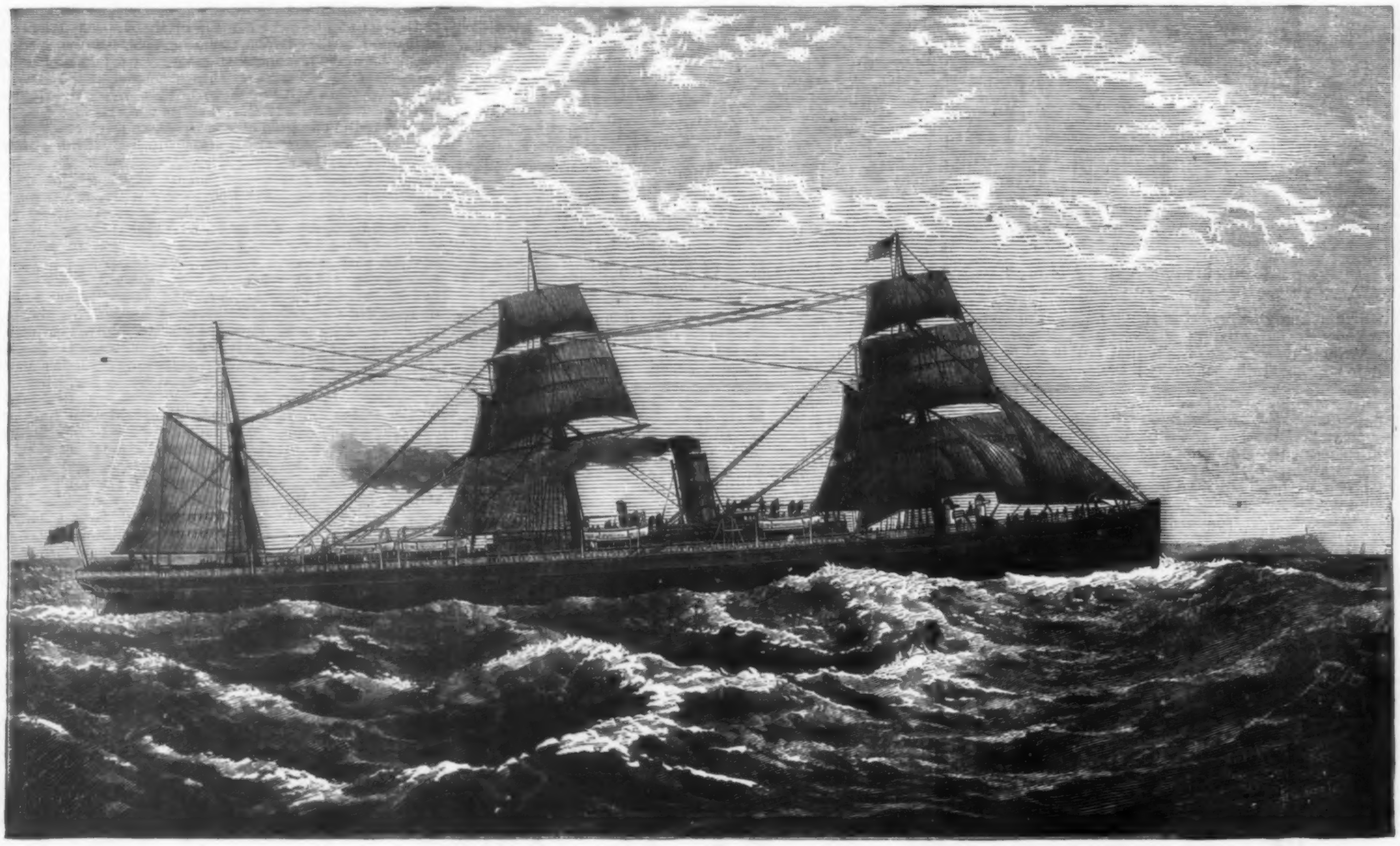
On her speed trials, which took place a few months ago, the engines of the Gallia gave out 5,300 indicated horse power, and the vessel has since proved that in actual practice crossing the Atlantic she can maintain that power, as the mean of a recent voyage home from New York was 5,261 indicated horse power, on a consumption of coal which never exceeded 98 tons per 24 hours. These results are equal to 1·73 lb. of coal consumed per indicated horse power per hour.

Speaking of the speed of the Gallia, we should in the first instance say that she was not specially designed for attaining a degree of swiftness that had heretofore been unequaled in first-class Atlantic liners. The builders came under a guarantee to the Cunard Company that she should steam at least one-half knot faster than the Bothnia and the Scythia, the two vessels which were added to the fleet immediately before the Gallia; in other words, she was to have a speed of not less than 14·3 knots per hour. Her actual speed on her progressive speed trials was equal to 15·9 knots per hour; and on the following day, when she made an experimental cruise in the Firth of Clyde, she ran the measured mile in 3 minutes 45 seconds, which was equal to 16 knots, or 18¼ statute miles per hour, or 1·7 knots over the guaranteed speed. In her voyages to and from New York hitherto she has scarcely ever had anything but gales ahead, in consequence of which she has not yet had a chance of making what may be termed a "crack" run. As it is, however, she has attained speeds ranging up to 383 knots per 24 hours, and has made the run from Queenstown to New York in 7 days 19 hours, which means that she has become a Monday ship instead of a Wednesday ship, in respect of her arrival in New York.

The foregoing are undoubtedly important results, especially when compared with those attained thirty-nine years ago by the pioneer boats of the Cunard Line; indeed, they may be spoken of as extraordinary. But in these days of keen competition in the Atlantic steam shipping trade there can be no "finality," though, for a time, steamship owners may "rest and be thankful." Steam navigation, however, is a highly progressive art, and hence the Cunard Company cannot afford to remain permanently satisfied with a speed of 7 days 19 hours from port to port. When the length of the voyage is reduced to six and a half days) which we believe to be one of the possibilities of the immediate future, there will certainly be some room for congratulation. It remains to be seen whether or not it will be the good fortune and proud distinction of the Cunard Company to be the first to attain that result.

On the occasion of the launch of the Gallia it was stated that she was the forty-first steamer which Messrs. James & George Thomson had built for Messrs. Burns—a total of upward of 90,000 tons and 17,000 horse power nominal. It was further remarked that the Cunard Company had resolved that they would be up to the requirements of the day in speed, and at the same time have their ships equipped with everything necessary for the comfort and convenience of passengers, in fact, they mean to go ahead and let none outstrip them.

That the Gallia has already established herself as a great favorite with travelers across the Atlantic, as already indicated, is shown by the following facts. In her first outward voyage, which was made in April last, before the regular traveling season had begun, she had over 200 saloon passengers aboard; while in her first homeward voyage all her accommodation was taken up with passengers, and it was likewise all secured in advance for several subsequent homeward voyages. When she set sail for New York on her last outward voyage, on August 23, she had upward of 300 saloon passengers with her, a number of whom had entire staterooms to themselves.—*Engineering.*



THE NEW CUNARD STEAMSHIP "GALLIA."

THE SEVERN BRIDGE.

THE bridge across the river Severn is now completed.

The engineers who promoted the scheme of the bridge railway, designed the bridge, and carried out the work, are Mr. George William Keeling, M. Inst. C.E., Lydney, and Mr. George Wells Owen, C.E., Westminster; the consulting engineer being Mr. Thomas E. Harrison, M. Inst. C.E. The contracts were signed as follows: The bridge to Hamilton's Windsor Iron Company, Liverpool, £190,000; and the railway, with viaduct, £90,000, to Messrs. Vickers & Cook, London, who by arrangement gave up the completion of the contract, viz., the railways, and that portion of the undertaking has since been carried on by Mr. Griffith Griffiths, of Dean Forest. Some time elapsed after the Parliamentary powers had been obtained before the starting of the works, mainly from the high prices and expensive labor then prevailing. The foundation stone was laid on June 3, 1874.

The bridge is on the bowstring principle, and consists of the following spans: One of 134 ft., two of 327 ft., 5 of 171 ft., 13 of 134 ft., and one—including a swing bridge over the Gloucester and Berkeley Canal—of 196 ft., making 22 in all. The two spans of 327 ft. are across the navigable part of the Severn, and in ordinary spring tides afford a headway of 70 ft. above high-water mark. In the other cases the headway varies according to the gradient of the bridge—1 in 140. The piers, moreover, vary according to the weight they have to carry. Those bearing the wider spans consist of four cylinders, each of which is 10 ft. in diameter from the foundation to low-water level, and 7 ft. to the top of the pier, and upon which the girders take their bearings. The piers of the five 171 ft. spans consist of two cylinders only, each 9 ft. in diameter to low-water mark, and from thence 7 ft. The width of the river is 1,186 yards, and the entire length of the bridge, inclusive of the viaduct on the Forest shore, and the swing bridge across the canal, is 1,387 yards. It has been constructed for a single line only, although the railways, including the tunnel, have been made for a double line of rails. The total length of railway from Lydney, where the line commences, to Sharpness is about five miles. The superstructure of the bridge consists of bowstring girders resting on iron columns, and to allow of vessels passing up the canal the structure terminates on the Sharpness side with a swing bridge 500 tons in weight and about 200 feet in length. It has a double opening, and rests upon a circular tower of masonry. One of the openings of the swing bridge is across the canal, and the other over the adjoining shore of the river. The engine and machinery for turning the bridge are so arranged that there shall always be a reserve boiler, engine, and machinery, to provide for repairs or in case of a breakdown. The locking is effected by iron wedges driven by steam, lifting the bridge, and causing it to take a solid bearing on the piers. The viaduct on the Lydney side of twelve arches 70 ft. high, constructed of stone from the Forest of Dean, is a fine piece of masonry.

The scaffolding used in the bridge was, from the nature of the undertaking, peculiar, and the details of the temporary structure are of interest. Before starting the piers the contractors had, during the neap tides, from barges, which were fixed, to drive three rows of piles. As soon as they had been driven a scour was caused, which carried away all the sand in the bed of the river in their immediate vicinity, leaving bare the clay and gravel, of which there were about 8 ft. in depth on the rock. Then the piles were braced together, an operation which had to be performed by divers, as the necessary 'work must be done beneath the low-water level. If the piles could not be braced together before the spring tides came all was swept away, and the task must be commenced afresh. With favorable weather, however, the men succeeded in this portion of the preliminary work, but the force of the tide was so great that to give the stages sufficient stability to resist it they were built 150 ft. in length, although the piers were only 20 feet wide. After the scaffolding thus far was completed, a framework was formed on the top just large enough to take the cylinders and the upright guides requisite for preserving the cylinders in position as they were lowered. When the framework was ready the cylinders were brought to the spot in 4 ft. lengths, and fastened together by flanges and bolts inside. The lengths were placed inside the framework and lowered by means of long screws, having links attached, and as one length disappeared below the top of the framework, a second was bolted on, and the lowering process continued. As the screws ran out they were taken off, and links 6 ft. long attached. Thus the lowering process went on, length being added to length, until the cylinder reached the level of the clay and gravel; and when this point was attained, men in the ordinary diver's dress descended, to excavate a hole that the cylinder might be steadied. Then the cylinder was built up by adding 4 ft. lengths until it appeared 15 ft. or 20 ft. above high water. The next process was to fix an air bell to the top. This was bolted on so that it formed a chamber from the air bell to the bottom of the cylinder; and an engine and air-pump being brought out, air was forced into the cylinder until all the water was thrust out of the bottom. Through pressing air into the cylinder, much increased flotation was given to it, and this rendered it imperative to load the cylinder in order to overcome the buoyancy. That each cylinder might be kept down it was loaded with about 150 tons of iron rails. The men at work had to pass into the bell through an air trap which gave admission to an antechamber, the outside door being then closed, and as soon as the compressed air in the ante-chamber became of the same density as that of the cylinder communication was permitted from the ante-chamber. In this manner also the excavated material was passed out and concrete and bricks as needed passed in. When the water had been forced from inside the cylinder a man descended and excavated the clay, the cylinder dropping gradually as the excavation went forward, until it reached the rock. Then the rocky bed itself was excavated to the depth of 4 ft.; and as soon as the engineer was satisfied of the firmness of the foundation the cylinder was filled with concrete and the piers carried to their full height, being loaded with concrete to the top. On the top of these columns of concrete the weight of the bridge was supported, the iron cylinders being merely a casing.

A task of some difficulty was that attending the construction of the scaffolding for the two large spans; and after some consultation the contractors decided to have three temporary piers of scaffolding between each of the two wide spans, and these trussed. The men had to rely entirely on wood to carry up the intermediate stages, and it was necessary to have a base of 150 ft.; using 34 large balks of timber from 55 ft. to 60 ft. in length, and averaging 16 in. square, to form the bays of the intermediate stages. As a start the pile-driving apparatus was placed in position, and three piles were driven if possible during low water. These three piles were then braced together to assist each other in

resisting the pressure of the water until the remainder could be driven. As the process of driving advanced, the piles were continually braced from tide to tide until 34, forming one intermediate stage, were driven. When a sufficient number of piles had been driven the driver put on the bracings, which consisted of half-timbers varying from 50 ft. to 80 ft. in length. To get these as close to the gravel as possible efforts were made with slip channel iron arrangements, and they were bolted. The bolts in connection with the channel irons were closed by divers, and this bracing was fixed to the other piles by 1¼ in. bolts. These piles were only sufficient to bring the base of the stage to low-water mark; and after the whole of the under-water work was thoroughly braced, arrangements were made for carrying the scaffolding to its required height. It was necessary in the two outer rows to have the piles doubled, in order that sufficient strength might be afforded to support the immense weight of the superstructure. These double piles were carried up so as to receive the end of the temporary trusses, on which planks were laid to form a continuous platform. It was only at extreme low water that the bases of these stages could be put in; but by means of the electric light the men could work every tide until the stage was brought to high water, there being a spring tide every fortnight.—*Building News.*

MACHINERY IN FLOUR MILLS—COST AND DEPRECIATION.

By A. J. WATERS, Cleveland, Ohio.

THE number and style of mills are almost legion—from the old water mill on the creek where in our boyhood days we took our first lessons in machinery and cultivated the gift of patience while waiting for the grist, to the magnificent brick edifices with all the modern improvements of separators, bran-dusters, middlings purifiers, and hazardous elements of a powder mill, the distance seems almost inconceivable, and yet the march of improvement has traversed the distance, and the insurance companies have paid for the passage.

While the work of progress is on nearly every part of the machinery of a mill, one old land-mark yet remains—the "upper and nether millstone" of centuries ago, which ground the wheat of the Pharaohs, are substantially the same as to-day.

The old French quarry still turns out the best burrs known to the trade. These are usually from 30 inches to 54 inches in diameter. A 30-inch stone will cost $75, and $6 for every additional inch. This is for stone simply faced; if both faced and furrowed, add to the above 15 per cent. The average price of all the irons necessary to set the stone is about $100. Cork and feeder, $25, and $25 for settling the stone. The actual wear is but little. The depreciation of a good pair of burrs in 25 years would hardly reach 20 per cent. In a merchant mill they will need dressing about once a week, giving employment of a day's work to the millers. Frequently after a fire the burrs will look scarcely injured, and yet a small amount of heat will render them entirely worthless. Their component parts are lime and marine shells. The spur wheels which drive the stones will need refilling about once in six to eight years, at a cost of from $100 to $150, depending upon the size of the wheel.

Bolting chests, as sent from the manufactory, comprise a paneled or cylinder chest, iron reel, cloth made up for it, and driving gearing. A 16-foot chest and 40-inch reel, as above, including one 12-foot elevator, will cost $360, and a 20-foot chest, $540. Merchant mills have chests from 2 to 4 reels. The latter, with cloths, shafting, and gearing, will cost about $1,500. Iron bolting reels are worth from $40 to $50. The bolting cloth is made from the best quality of silk, and varies in price from $1.25 to $3.50 per yard, according to quality. To this 35 cents per yard is added for making up ready for the reel. A 40-inch reel requires one yard of cloth for each foot in length of the reels. The wear on a bolting chest is mainly confined to the cloth. This will depreciate in value from 25 per cent. to 33⅓ per cent. per year. When the mill is old the depreciation is more rapid, owing to the bugs frequently destroying the meshes of the cloth. About 3 per cent. is the annual depreciation of the rest of the chest.

MIDDLINGS PURIFIERS.

These are of various patterns, some doing their work by means of a cloth and bolting chest, and others by a current of air. A machine sufficiently large for a burr mill will cost $275, and $100 additional for every extra burr. The average life of a purifier in a merchant mill is eight years, or a depreciation of 12½ per cent.

A few millers insist that 5 per cent. is high enough.

SMUTTERS AND SEPARATORS.

"Where is the smutter located?" used to be a formidable question; and when found on the second or third floor, and the secretary of the company would return the application on that account, I early imbibed the idea that that particular machine was my special enemy, in flouring mills, owing to its prominence in decreasing my commission account. At times I could not see much sense in the company's rejection of the risk, and, after watching the machine and talking with the miller, I would be sometimes possessed with the heresy that the secretary never saw a smutter, and would not know one if he did see it.

All the satisfaction I could get was, that the rapid motion (600 revolutions per minute) was apt to generate heat by friction. This I would quietly accept, and then solemnly ask the miller the next question: "Are the lower boxes kept constantly filled with tallow?" One irreverent Yankee wanted to know if the insurance company thought he kept them full of water, and I was further perplexed with the query, whether the company thought he was such a consarned fool as to try and save a few ounces of tallow, and cut out the journals and boxes of a $200 smutter.

Somehow the miller's arguments struck me more forcibly than the attempted points of the secretary. And when he referred to a shaper in a neighboring furniture establishment, which buzzed around at the rate of 6,000 revolutions a minute, and wanted to know if the application said anything about that, and whether it was required to be on the first floor or in the basement, I confess I left the mill with a very poor appreciation of the knowledge of the man who originated those flouring mill applications.

Dropping the experimental part of my subject, and returning to the figures, I find that a smutter cleaning from ten to fifteen bushels of wheat per hour is worth $110, and one with a capacity of 125 bushels, $250. In custom mills smutters have run twenty years, and show no material decrease in value. Merchant mills rarely use them longer than ten years. A smutter can be recased at a cost of from $15 to $30, making it almost as good as new.

ELEVATOR CUPS AND BELTS.

The cost of the belts varies according to length and quality. The cups range from 3 in. x 8 in. x 4 in. to 10 in. x 5½ in. x 6 in. The former cost 15 cents, and the latter, 50 cents, each. The iron elevator boot and pulley will cost $12; fastening the cups to the belt, 2 cents each, and $1.50 per hundred for Norway iron bolts to fasten them on. The principal wear in elevators is confined to the cups.

A good belt in a merchant mill will last from ten to twelve years, while the cups will need replacing in from six months to two years. Taking all the elevators in a mill doing merchant work, and 8 per cent. will cover the depreciation, and on the average custom mill, 5 per cent.

A practical mill furnishing man, and one who has often acted as appraiser for insurance companies, says that generally he estimates 5 per cent. depreciation annually for all the slow-geared machinery, and 10 per cent. for the fast. His impression, however, was, that the estimate was rather strong, and millers in general seem to entertain similar ideas, and incline to materially reduce the per cent. named.

BELTING.

How long will a belt wear? is almost synonymous in its indefiniteness with the query, "How large is a piece of chalk?" There are so many "conditions, limitations, and requirements," to keep within insurance language, entering into this solution of the question, that a mere knowledge of one or two will hardly produce a satisfactory result. Among the variable elements entering into belt depreciation may be mentioned its length, width, and thickness, speed, friction or power to transmit, tension, proper adjustment, and temperature. If the belt is of leather, and oak tanned, it will last one-third longer than a chemical tanned. The manner in which belting is laced or joined together makes a great difference in the wear. Having each end of the pieces to be joined cut off true and square, and laced not too tightly, and the wear of the belt may be decreased 2 per cent. per year.

Some of the methods used to prevent a belt slipping on the pulley are detrimental to its wear, among which may be mentioned powdered rosin or pitch, which soon penetrates the leather and rots the belt. Roughing the surface by filing is another source of wear. Running the belt on too tight a pulley will generate heat, decompose the oil and organic matter in the belt, and hasten decay. A belt of unequal thickness will not only run badly, but wear much faster than one of equal thickness throughout.

Rubber belts depreciate faster than leather. Frequently a few minutes of quick motion will roll the gum off in such quantities as to entirely destroy the belt. During freezing weather, if moisture finds its way into the seams or between the different layers of canvas in rubber belts and becomes frozen, the layers soon tear apart, and the belt is ruined. Again, if they are used for cross belts, shifting belts, on cone pulleys, or any place where they are liable to slip, friction soon destroys them. Using leather belts in damp places, or where steam comes in contact with them, materially hastens depreciation.

As an illustration of the variation of depreciation in belting, we may mention the large driving belt of a thrashing machine which will only wear a couple of years, and then compare it with the 36-inch driving belt of the Dayton car works, which has run continuously for ten years, and is virtually as good to-day as when first started. Short driving belts depreciate more rapidly than any others, and used to be replaced every ten or twelve months. Generally an eight to sixteen inch belt will wear from six to eight years. Taking all the facts into consideration, and the entire amount of belting used, a fair depreciation would be flouring mills, 10 per cent., iron-workers, 12½ per cent., and wood-workers, 20 per cent. Belts in contact with steam or moisture will depreciate 10 per cent. faster than when run in a dry place.

The cost of belting may be had from the dealers' catalogue, from the prices of which there is a discount from 40 to 50 per cent., and sometimes a small discount off that for net cash. The belting of a shop is a good criterion by which to judge of the value of the machinery of the shop. A person not a machinist might be bothered to tell whether the machinery of a shop was in good condition, or whether the business was profitable. These doubts can be materially lessened by a glance at the belting. If the general make-up is bad—if the belts are all patched, frayed out, or badly doubled at the edges, and have a sort of throwed-together look, or if there is a deal of wabbling on the pulleys, and a sort of general shabbiness throughout—it can be safely set down that the concern is hard up, or the machinery is badly worn, that there is a scarcity of work, and in all and singular this little index pretty surely points to the fact that your particular company don't want that risk.—*From paper read before the Northwestern Association of Underwriters.*

[Continued from SUPPLEMENT, No. 201, page 3199.]

THE POLARISCOPE AS APPLIED TO SUGAR MANUFACTURING AND BREWING.

By J. STEINER.

IN consequence of the different dispersion power of the monochromatic rays into which the white light is split up when passing a prism, a complete extinction of colors or a point of complete darkness in the polariscope can never be attained, and only the minimum of intensity has to be the guide of the observer. To obviate this inexactness, Biot inserted at P, Fig. 1, a plate of red glass, which prevents to a considerable extent the passage of some of the monochromatic rays, and his determinations or measurements relate all to the minimum of intensity of the red and yellow light, which alone, under such circumstances, pass into the apparatus.

Soleil and Duboscq, who studied subsequently the question of the polariscopical sugar estimation, constructed a "saccharometer" which, although the common white lamp

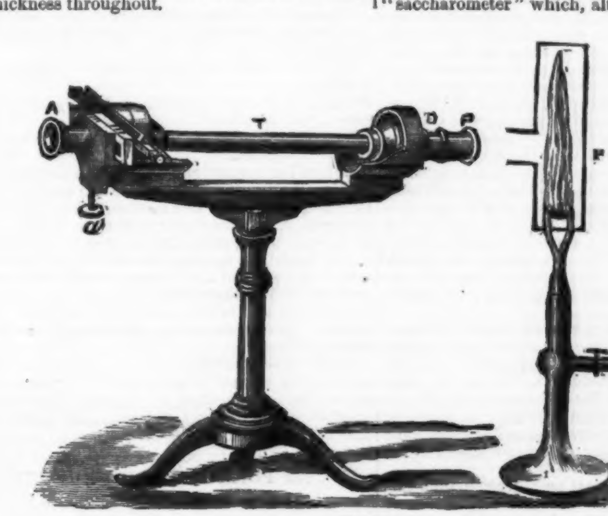


FIG. 3.

light is applied for it, permits of a most accurate regulating and a very sharp observation if the solutions under examination only be pale. This instrument became soon a favorite with the French beet sugar manufacturers, and its fame having reached the border country, it pushed aside the Mitscherlich, after having been considerably improved in its construction, first by Ventzke and then by Scheibler, and is now in general use in Germany under the name of Ventzke-Scheibler or Soleil-Scheibler.

The principle on which Soleil based the construction of his instrument lies in the fact that quartz disperses the single rays of the white light to exactly the same degree as is done by a sugar solution; hence, if a rock crystal of a left-handed rotation be selected, the deviation of the light caused by the right-handed rotating cane sugar solution can be compensated by such a quartz of a certain thickness. It is clear that under such circumstances there is no more the former objection to the use of complex or white light.

Fig. 3 is a sketch of the simplest form of such a "po-

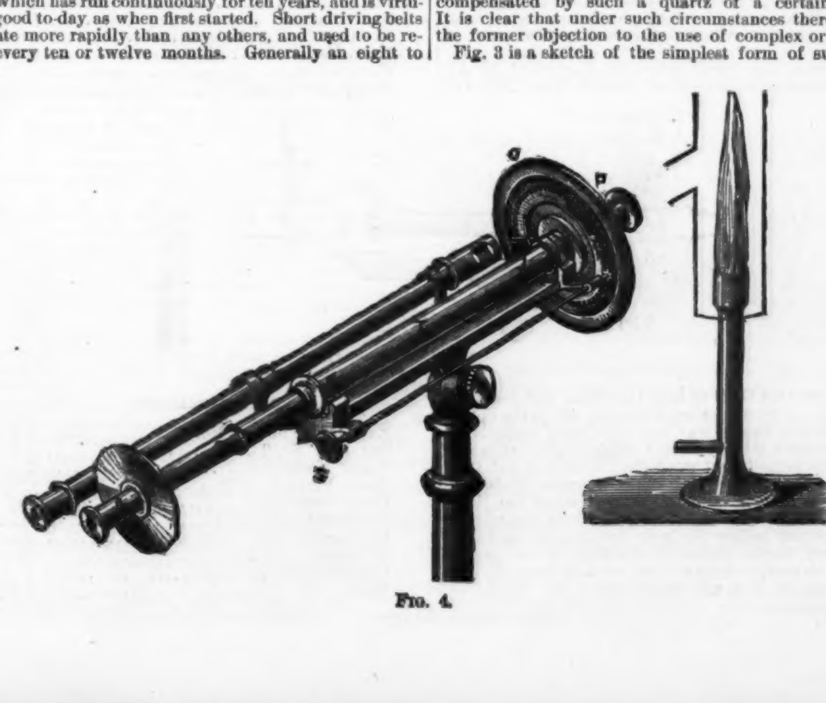


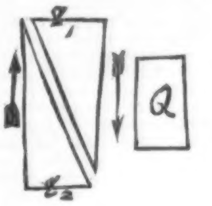
FIG. 4.

larimeter." The light from an Argand lamp penetrates into the instrument by P, passes on its way first the polarizing Nicol, then immediately afterward a double plate of quartz, D, the one-half of which is right-handed, and the other left-handed rotating, and it moves now on through the tube, T, containing the sugar solution. In A is the analyzer Nicol, which in this case is not movable, but fixed in a position parallel with the polarizer in P.

Between T and A is now this portion which is peculiar to Soleil's instrument—the compensator—and which consists of three parts.

On leaving the sugar solution in T, the light passes through Q, which is a quartz plate of no specially determined thickness, and it enters then q_1 and q_2, two other but wedge-shaped quartz plates, which possess a rotatory power the reverse of that one in Q. These two wedges form therefore together a plate of variable thickness, according as they are more or less pushed over each other, and at a certain position their common thickness is equal to that one of Q, when the deviation of the passing light caused in Q is just counteracted or compensated in q_1 and q_2. Each of the two wedges is set in a brass frame connected with the screw, a, so as to make them slide in opposite directions to each other, by which arrangement the operator can suit his desire, and on taking notice of an ivory scale fixed on the top of the one wedge, and of the index fixed on the other, he is enabled to account for the amount of displacement produced.

On looking through the empty apparatus when the zero of the scale and of the index coincide, a (*slightly blue*) field of sight colored and divided by a vertical line (*i. e.*, the joining line of the two parts in D) will be observed. If



now the glass tube, T, filled with a sugar solution, be inserted, the color of the part with a right-handed rotation in the double plate, T, gains in intensity, while the other with the opposite rotatory power loses in the same ratio, hence the two halves of the disk of sight have no more the same tint, and it requires an adjusting by the aid of a to attain the former equality of color. Carefully performed experiments showed that a solution containing 16·35 grammes of crystallized cane sugar in 100 c. c. causes in a 200 mm. tube the same rotation as a quartz plate of 1 mm. thickness, and Duboscq divided the distance corresponding to such a displacement of the wedges into 100 divisions, so that each division on the right-hand side of the scale equals 0·1635 gramme cane sugar. Ventzke, on the contrary, used for his original researches a sugar solution of 1·1 specific gravity (corresponding to 26·048 grammes in 100 c. c.), marked the deviation caused in this case with 100, and arranged his scale so that each division indicates 0·26048 gramme of "crystallizable sugar" in 100 c. c. solution.

The improved instrument of Ventzke and Scheibler contains moreover several other, by means of a screw with a long gearing, movable prisms, and quartz plates near P, the object being not only to produce a variety of tints suiting the special sensitiveness for different colors of each individual operator, but also to counterbalance as much as possible any inaccuracy in the observation arising from some solutions under examination being either too brown or too dark.

Indeed this latter defect is so great an objection that this instrument, with all its advantages in other respects, is of little use when substances either partly caramelized (like molasses, jaggery or China sugar), or others more or less colored brown from cooked albuminous matter (like most common heavy ales), or even black beers (porter and stout), are to be polarized. For such cases two instruments, with the use of monochromatic yellow light (*i. e.*, of a Bunsen flame colored yellow by the evaporation in it of common salt), have been devised and constructed, and they answer in all respects our purposes.

The advantage in applying the yellow flame culminates in the fact that such brown solutions as the brewer and sugar refiner have to deal with absorb and retain mostly the violet and blue rays, hence only the yellow rays can pass through the instrument and are noticed by the observer, who, moreover, can improve any weakening effect by brightening the flame, and then make his observations without experiencing difficulty from any diminution in sensitiveness.

Fig. 4 is a perspective view of an improved apparatus devised by Wild, called by him polaristrobometer, and a simple form of it was first constructed by Hoffmann in Paris.

This instrument consists in principle of a Nicol (in A), and a short telescope with a pair of crossed lines, followed

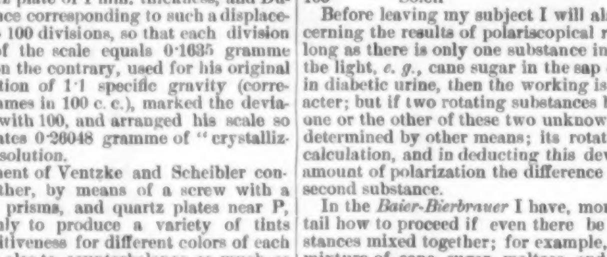


FIG. 5.

by a double plate (in D) of 20 mm. thickness, and composed of two plates, cut from rock crystal under 45° to the optical axis, and joined in such a way that their main sections are rectangular to each other. Such a double plate shows, if observed in polarized light when the Nicols in A and D are parallel or rectangular to each other, a system of alternate white and black stripes, which disappear when the Nicols have an inclination of 45°; hence, on looking through the empty instrument before the scale is adjusted, the fringes will be noticed, but on carefully handling S, the gearing which is in connection with a screw, so as to make the disk, C, and the tube, P, with the Nicol rotate, the stripes will make room for a bright yellow band, the center of which coincides with the picture of the common point of the two crossed lines in the telescope. The scale, we will find, is now so arranged that at this bright sight in the instrument the index, J, points to zero.

There are two scales: the one for cane sugar determinations only, and indicating, if a 200 mm. long column be inserted, for each division one gramme of sugar in one liter in solution; while the other, representing angular degrees, can be used in a general sense, and for brewing purposes I will note that the rotation of the yellow rays in a 200 mm. tube amounts—

For 1	gramme of	Dextrin	dissolved in	100 c. c. to	3·4∢°
1	"	Maltose	"	"	2·5
1	"	Dextrose	"	"	1·06

In working with a yellow flame there are always two advantages for the observer: first, that the disappearance of black can more easily and closely be watched than any change of color; and, secondly, that the defect of Daltonism is of no consequence whatever here.

All the good qualities which Wild's instrument possesses are attached also to Laurent's Pénombre, Fig. 5, which is the latest practical application in this direction of the principles of polarized light. In combining the simplicity in construction of Biot and Mitscherlich (which in fact it resembles) with the exactness of the working of Soleil Scheibler and of Wild it has, although only about three years in existence, already taken the place of the French Soleil, and is now used by the French Inland Revenue officers for ascertaining the amount of "drawback" due to the manufacturer for taxes paid on exported sugar.

F is a monochromatic flame. D is a crystal of bichromate of potash, which allows only the yellow light to pass through it. P and A are the Nicols, and both are movable, *i. e.*, P by means of H to let more or less light into the apparatus according as the sugar solution in T is brown or pale, and A, which is fixed to the disk, C, by means of the screw, S, to adjust the instrument. J indicates the degree of rotation on a scale, the reading of which is facilitated by the magnifying power of L. The disk bears in its upper part a sugar scale (for 26·0·8 grammes or 16·35 grammes in 100 c. c. solution), and in its lower half it shows angular degrees. If empty and adjusted the field of observation appears with a soft yellow tint, the half of which darkens when a polarizing liquid is inserted; but as one-half of the field remains intact, the original tint can easily be restored in the second half.

The working is therefore very simple; and in conclusion, I should like to remark that I prefer this instrument to any other polarimeter.

There remains now for me only to compare the different scales:—

100 dgs. of	Ventzke-Scheibler		=37 angular degrees.
100 "	Soleil		=23 "
100 "	Ventzke-Scheibler	on Wild or Laurent	=34·6∢°
100 "	Soleil	" "	=21·6

Before leaving my subject I will also add a few hints concerning the results of polariscopical reading in general. So long as there is only one substance in solution which rotates the light, *e. g.*, cane sugar in the sap of the cane or glucose in diabetic urine, then the working is of the simplest character; but if two rotating substances be in solution together, one or the other of these two unknown substances has to be determined by other means; its rotation is then found by calculation, and in deducting this deviation from the total amount of polarization the difference is the rotation for the second substance.

In the *Baier-Bierbrauer* I have, moreover, explained in detail how to proceed if even there be three polarizing substances mixed together; for example, how to determine in a mixture of cane sugar, maltose, and glucose or dextrose, maltose and dextrin.—*London Grocer.*

FORMULÆ FOR PERFUMERY.

By ALEX. B. LEVI, PH.G.

TINCTURES are made in the following proportions, using in all cases one pint of cologne spirit:

Tincture of Ambergris—Ambergris, ʒ ij.
" Benzoin—Benzoin, ℥ iv.
" Civet—Civet, ʒ ij.; magnesia carb., ʒ ij.
" Musk—Musk, ʒ iij.; hot water, ℥ viij.
" Styrax—Styrax, ℥ ij.
" Tonquin—Tonqua beans, ℥ iv.
" Turmeric—Turmeric, ℥ ij.
" Tolu—Tolu balsam, ℥ ij.
" Peru—Peru balsam, ℥ ij.
" Vanilla—Vanilla, ℥ ij.
" Vetivert—Vetivert root, ℥ ij.

The following formulas for compounding the handkerchief extracts have been used for several years and met with much success:

JASMIN.

Ext. Jasmin	f. ℥ vj.
Ext. Tuberose	f. ℥ iij.
Ext. Jasmin, No. 2	f. ℥ vj.
Tinct. Musk.	f. ℥ iss.
Tinct. Civet.	f. ℥ j.
Orange flower water	f. ℥ iij.

FRANGIPANNI.

Ext. Orange flower, No. 1	f. ℥ viij.
Ext. Rose No. 2	f. ℥ iv.
Tinct. Musk	f. ℥ j.
Tinct. Vetivert	f. ℥ j.
Powd. Orris	ʒ ij.
Oil Santal	♏ xv.
Oil Neroli	♏ xv.
Oil Rose	♏ viij.
Cologne spirit	f. ℥ ij
Rose water	f. ℥ j.

ESSENCE BOUQUET.

Ext. Rose, No. 1	f. ℥ viij.
Tinct. Musk	f. ℥ j.
Orris root*	ʒ ij.
Oil Rose	♏ xv.
Oil Neroli	♏ xv.
Oil Bergamot	f. ℥ ss.
Oil Lemon	f. ʒ ij.
Cologne spirit	f. ℥ iij.
Rose water	f. ℥ ij.

YLANG YLANG.

Ext. Jasmin	℥ iv.
Ext. Rose	℥ iv.
Pulv. Orris	ʒ iij.
Tinct. Civet	℥ ss.
Oil Ylang Ylang	ʒ ss.
Cologne spirit	℥ v.
Water	℥ iij.

GERANIUM.

Ext. Cassie, No. 2	f. ℥ viij.
Ext. Rose, No. 2	f. ℥ iij.
Tinct. Benzoin	f. ℥ ij.
Tinct Musk	f. ℥ ss.
Powd Orris root	ʒ ij.
Oil Rose Geranium	ʒ iij.
Rose water	℥ ij.
Cologne spirit	℥ j.

NIGHT BLOOMING CEREUS.

Ext. Tuberose	℥ iv.
Ext. Rose, No. 2	℥ iv.
Ext. Violet, No. 2	℥ ij.
Ext. Jasmin, No. 2	℥ ij.
Tinct. Vanilla	℥ j.
Tinct. Benzoin	℥ ss.
Tinct. Musk	℥ ss.
Oil Nutmegs	♏ xv.
Oil Santal	♏ xv.
Oil Neroli	♏ xv.
Oil Almond	♏ viij.
Orange flower water	℥ ij.

HELIOTROPE.

Ext. Rose, No. 1	f. ℥ viij.
Ext. Orange flower, No. 2	f. ℥ iv.
Tinct. Vanilla	f. ℥ j.
Tinct. Civet	f. ℥ ss.
Tinct. Ambergris	℥ ss.
Oil Almond	♏ xv.
Rose water	f. ℥ j.

MUSK.

Tinct. Musk	℥ xij.
Tinct. Civet	℥ j.
Tinct. Ambergris	℥ j.
Tinct. Styrax	℥ j.
Tinct. Vanilla	℥ ss.
Rose water	℥ j.

MUSK, 2D.

Bruised Sumbul root	℥ iv.
Hot water	℥ iij.
Alcohol	℥ vj.
Tinct. Ambergris	ʒ iij.
Tinct. Vanilla	ʒ iij.
Rose water	℥ ij.

WHITE ROSE.

Ext. Rose	℥ viij.
Ext. Rose, No. 2	℥ iv.
Tinct. Civet	℥ j.
Pulv. Orris	℥ ss.
Oil Rose	♏ xv.
Rose Water	℥ j.
Cologne spirit	℥ ij.
Ext. Patchouli	℥ ss.

NEW MOWN HAY.

Ext. Rose	f ℥ iv.
Ext. Cassie, No. 2	℥ iv.
Ext. Orange flowers	℥ ij.
Tinct. Tonquin	℥ ij.
Tinct. Vanilla	℥ j.
Oil Cedrat	ʒ ij.
Oil Verbena	ʒ ss.
Orange flower water	℥ ij.

WEST END.

Ext. Tuberose, No. 1	℥ iv.
Ext. Jasmin, No. 2	℥ iv.
Ext. Rose, No. 2	℥ ij.
Tinct. Cedar	℥ ij.
Tinct. Tonquin	℥ j.
Tinct. Musk	℥ j.
Oil Lemon	ʒ j.
Oil Verbena	ʒ ss.
Oil Neroli	ʒ ss.
Orange flower water	℥ ij.

VIOLET.

Ext. Violet	℥ vj.
Ext. Cassie, No. 2	℥ iij.
Ext. Rose, No. 2	℥ iij.
Ext. Tuberose, No. 2	℥ ij.
Tinct. Ambergris	℥ j.
Oil Almond	♏ xv.
Rose water	℥ j.
Powd. Orris root	℥ ss.

PATCHOULI.

Ext. Rose, No. 2	℥ iv.
Ext. Orange Flowers, No. 2	℥ iv.
Cologne spirit	℥ vj.
Oil Patchouli	ʒ iss.
Oil Rose	♏ xv.
Rose water	℥ ij.

JOCKEY CLUB.

Ext. Rose	℥ v.
Ext. Cassie	℥ iv.
Ext. Orange flowers	℥ ij.
Ext. Jasmin	℥ ij
Tinct. Ambergris	℥ j.
Tinct. Musk	℥ j.
Oil Bergamot	ʒ ij.
Oil Rose	♏ xv.
Pulv. Orris root	ʒ iij.
Orange flower water	℥ ij.

* Instead of Orris root, a concentrated tincture of it would seem to be preferable.—EDITOR.

MILLEFLEURS.

Ext. Rose	℥ iv.
Ext. Tuberose	℥ iss.
Ext. Jasmin	℥ iss.
Ext. Orange flower	℥ iss.
Ext. Cassie	℥ iss.
Tinct. Vanilla	℥ j.
Tinct. Ambergris	℥ ss.
Tinct. Musk	℥ ss.
Oil Neroli	♏xv.
Oil Bergamot	♏xxx.
Oil Cloves	♏viij.
Oil Almond	♏vij.
Rose water	℥ ij.

TUBEROSE.

Ext. Tuberose	f. ℥ xij.
Tinct. Vanilla	f. ℥ j.
Rose water	f. ℥ ij.
Ext. Jasmin	f. ℥ ij.
Pulv. Orris	ʒ ij.
Cologne spirit	f. ℥ j.

COLOGNE WATER.

Oil Neroli	f. ʒ iv.
Oil Bergamot	f. ʒ iv.
Oil Lavender	ʒ ij.
Ext. Jasmin	℥ iiss.
Cologne spirit	Ovj.
Water	Oij.

Cologne water made by the formula given is an agreeable perfume, and has the soothing and cooling properties desirable in such a preparation.—*American Journal of Pharmacy.*

[For a series of additional recipes for perfumery with further directions, see the excellent paper by W. Saunders, in SCIENTIFIC AMERICAN SUPPLEMENT, No. 65.]

THE LONTIN ELECTRIC LIGHT.

It has long been acknowledged by electricians that for brilliancy and reliability the Serrin lamp left little to be desired, and it seems that that little has now been supplied in the Lontin, which is one step forward in the development of the same system. A number of scientific gentlemen and electricians lately met at the Three Nuns Hotel, adjoining the Metropolitan Railway, Aldgate, London, to hear, previously to examining the light in use on that line, an account of the progress made in perfecting the Lontin apparatus. The Lontin light has for some time past been and still is in successful use in Paris, and is not unknown to the inhabitants of and visitors to London, being that which was for some time exhibited in the Strand during last winter by Mr. John Hollingshead, of the Gayety Theater. Since that time, many little imperfections noticed by those interested have been remedied, and eight lamps are now in use at the Aldersgate-street Station of the Metropolitan Railway. At the meeting in question, the chair was occupied by Mr. Myles Fenton, the general manager of that line, and Mr. G. P. Harding, who first introduced the light in this country, and in whose workshops at Paris the machinery is at present constructed, having explained the details of the improvements which had been introduced since the system was first brought before the public, there was an interesting discussion, in which Mr. W. Crookes, F.R.S., Mr. Tomlinson, the engineer of the Metropolitan Railway, and others took part. The opinion was without exception favorable to the quality and efficiency of the Lontin lamp, but some fear was expressed that the present high price would probably limit its application.

The economy of the system was ably maintained by Mr. Bernard Godfrey, the engineer of the Lontin Light Electric Generator and Light Company, who, by the aid of samples of the various forms of the lamp, showed very clearly the progress made up to the present time. He explained that the first cost of the lamp was really less important than at first sight appeared, owing to the small number of electric lamps required for a given space and their durability, but to meet this popular objection efforts were still being made, and he hoped before long they would have a lamp in which the clockwork was entirely dispensed with, the result of which would be that even in first cost the Lontin would compare favorably with any lamp known. It is but nine months since the first practical application of the electric light for public illumination was initiated in London with the Lontin system at the Gaiety Theater, and it has already, in spite of the indiscretion of over sanguine projectors and the detraction of opponents, become admittedly a method of lighting which public bodies have to reckon with, being alone adapted, on the score of power, salubrity, cleanliness, and economy, under its present improved and improving conditions, to satisfy certain large special requirements. It is to meet these special wants that the above company has acquired the only complete system of lighting which now exists. In fact, without in any way depreciating the brilliant results obtained by other inventions, it may be fairly stated that, whilst one company deals with a machine of which the subdivision is limited, and another company with the utilization of a burner or candle, each having its special feature and being dependent on others for the rest, this company holds not only the Lontin generator, but also the regulators, lamps, and methods of subdivision which enable it to supply from its own resources a complete and practical system of lighting which is neither disagreeable in color nor painful to the eye.

It was claimed for the Lontin light that it has decided advantages over its rivals in steadiness, in divisibility, and in economy, the cost of the Lontin being 3d. as compared with 5½d. for the next cheapest light. The illumination of the Aldersgate street Station on Monday evening was brilliant in every part, although but eight lamps were used to light the whole of the platforms. The lamps were on four circuits, and the currents were supplied from a Lontin generator producing alternate currents and making only 400 revolutions per minute. The motive power was obtained from a Fowler's semi-portable compound engine, high pressure cylinder 9 in. diameter, and low pressure 16 in. diameter, with about a 14-in. stroke. The steam was used at 112 lb. pressure on the square inch, and the engine was making about 130 revolutions per minute. From these data practical men can calculate approximately the number of indicated horse power used. It is intended with the same machinery to illuminate the Moorgate-street and Farringdon stations also, which will be a severe and conclusive test of the efficiency of the system. It is stated that the light may be divided very greatly. As many as twelve lights have been placed in one circuit. It has been shown practically that by this machine it is possible to give a larger number of small lights; and so far as experience has hitherto gone, whatever loss there may be in illuminating power is much more than compensated by the convenience of so complete a distribution; however, curiously enough, up to a point which at present appears to be between four and six lights on a circuit, a positive gain is obtained by division. These experiments are not yet completed. A machine constructed nominally for twelve lights (which would mean twelve lights of 600 candle-power each), may be arranged to produce 48 lights, should the nature of its application make such division desirable. The various patents which are the property of this company include special regulators and lamps, as well as special materials for cables and insulation, so that the whole apparatus necessary for the purposes of electric lighting used in this system is to a great extent peculiar to itself, and constructed under its own direction and control. The experiments on Monday evening were in every respect satisfactory, and promise much for the future of the light.

[*Nature.*]

THEORY OF THE TELEPHONE.

EXPERIMENTS that I have recently made with a Bell telephone have convinced me that the sounds produced are the result of molecular change in the iron disk, and are the same in kind as those heard in the telephone of Reiss.

My experiments were made with a carbon transmitter and Bell receiver, using a small battery to generate the current. First I removed the bar magnet from the receiver, in accordance with a suggestion made by a writer in *Nature* some months ago. The effect without the magnet was the same as with it. It then occurred to me that the intensity of the sound might be increased by using two disks instead of one. Accordingly I cut two circles out of a piece of sheet iron, leaving a narrow strip of the metal to connect them, of sufficient length to enable the disks to lie on either side of the reel, so as to form, in fact, an armature to the electro-magnet. On experimenting with this my anticipations were fully realized, the sound produced being more than double that from a single disk.

Now, while trying these experiments I held the disks loosely in my hand, without their being in any way fastened to the wood holding the reel, the effect being the same as if firmly secured. In fact, a common dinner knife or a rough piece of iron would emit sound if brought near enough to the core of the electro-magnet.

I have since constructed a very efficient telephone receiver out of a block of wood two inches square and three-quarters of an inch thick. I then drilled a hole sufficiently large to receive the reel, and covered the block with thin sheet iron. It needs no ear-piece, and forms the most effective telephone receiver that I have seen. But, still further to prove that the sounds produced are due to the magnetization of the iron of the disk, and not to mechanical vibrations resulting from the electro-magnet, I made an iron reel, the flanges of which were two inches in diameter. Now, on covering the reel and placing it in circuit, the flanges of the reel gave out sound as clearly as in the Bell telephone. In my judgment this experiment renders it conclusive that the sounds proceed from the magnetization and demagnetization of the iron, and are therefore precisely the same in character as those formed by a Reiss receiver.

PERCIVAL JENNS.

St. John's Rectory, British Columbia.

THE CONSOLIDATION OF FLUID STEEL.*

By ALFRED DAVIS, Westminster.

THE difficulty of obtaining solid ingots under the ordinary system of casting in the Bessemer and Siemens process has induced several methods of applying pressure to the metal whilst in a liquid state.

Sir Henry Bessemer, in 1856, took out a patent, under the title of "Manufacture of Iron and Steel," in which he proposes to use a hydraulic press as a means of condensing the ingot whilst in a semi-fluid state, and for which purpose he states a strong slide or cover must be made to close the mouth of the mould during the process.

The plan adopted by Sir Joseph Whitworth has been for some time in successful operation, and the process of hydraulic compression has also been practiced at the works of Messrs. Revollier, Bictrix & Co., France, and at the Neuberg Works in Austria.

Mr. R. N. Daelen, of Barop, has a plan for pumping the fluid steel into a closed ingot mould. The three last systems are fully illustrated and described in the pages of *Engineering*, August 6, 1875, and October 8, of the same year, and are probably well known to the members of this Institute.

The system which the author proposes to describe is the invention of Mr. H. R. Jones, of the Edgar Thomson Steel Company, U. S. A., and is now in constant operation at the works of that company near Pittsburg.

The process is a very inexpensive one, and consists in simply admitting steam at a high pressure to the top of the ingot mould immediately after the metal has been poured.

A steam drum or receiver, communicating direct with the boiler, is fixed, for the sake of convenience, to the side of the ingot crane. This drum has a number of cocks corresponding with the number of the moulds. India-rubber pipes are provided to conduct the steam, one end of the tube being permanently fixed to the drum, and the other by means of a coupling attached to the lid of the mould.

The base-plates upon which the stools rest are secured to a good foundation, and the stools are accurately fixed in position on the arc of a circle having the post of the ladle crane as a center. This is done to avoid racking in and out the ladle when pouring. The stools have projecting ribs to fit the base plates, and heavy lugs to which the moulds are clamped.

The ingot mould has at the upper end a cone seat accurately turned, upon which the pouring cup rests, and which afterwards receives the lid, which is secured in position by means of a steel wedge.

By this arrangement the cup is easily removed and the lid (with coupling and flexible pipe attached) substituted; the cone seat forming a steam-tight joint.

In coupling up the steam pipe, a shorter time is occupied than by the old method of filling up with sand.

For generating steam a cylindrical boiler is used, 30 in. in diameter by 20 ft. long, and constructed to carry a pressure of 250 lb. per square inch, although in practice a greater pressure than from 80 lb. to 150 lb. does not appear to be necessary, the higher pressure being used for mild steels.

The result obtained by the application of this process at the Edgar Thomson Works has proved completely successful.

Formerly at these works, with a 14 in. ingot reduced to a bloom of 7¼ in. + 7¼ in., it was necessary to cut off from 30 in. to 36 in. of the bloom in order to arrive at a part free from piping, whilst under this process the ingots are free from porosity, and are turned out with a perfectly level top.

A careful series of experiments has been made in order to ascertain the difference between an ingot cast in the ordinary way and one under steam pressure; and it has been found that the latter, with the same quantity of metal from the ladle, is from 1½ in. to 2 in. shorter than the former when cold.

In the year 1878, when this process was first adopted, a saving of 2·6 per cent. was effected over the proceeding when the old method was in use; that is to say, what in the year 1877 was scrap, in the year 1878 was sound steel.

In addition to the consolidation of the ingot, there are several other advantages in this system. It is found that the steam, acting upon the end, cools and hermetically seals the top of the ingot, and enables the men to deal with it ten minutes earlier, without any fear of bleeding; and this allows the ingot to be conveyed to the reheating furnace with greater rapidity and in a hotter condition than formerly.

It is also found that with the use of steam the ingot moulds last better, the average in 1879 being 95 ingots, or nearly 112 tons of steel per mould.

In a paper read by Sir Joseph Whitworth, at the meeting of the Mechanical Engineers, in Manchester, July, 1875, several theories were discussed as to the effect of compression on fluid steel, and although the result was generally admitted to be satisfactory, the subject was dismissed before any solution had been arrived at as to the *modus operandi*. During the discussion several speakers were of opinion that the gases were not forced out, but merely compressed, and consequently occupied so small a space that they could not afterward be detected.

Mr. Daniel Adamson considered that the soundness of the compressed ingots could be accounted for in the following manner: That the metal running into the mould necessarily became cooled and solidified on its outer surface first, and that the natural contraction of the interior afterwards becoming cool must leave vacuous pores if allowed to cool in the ordinary way; but that the compression taking place during the time that the outer surface was becoming solidified, the metal was welded together particle for particle, and the vacuous spaces avoided.

Sir Joseph Whitworth did not offer any explanation in regard to the expulsion of the gases under his system of compression, and it would be interesting to know the views he entertains on the subject.

Dr. Siemens observed that the result might be accounted for by the circumstance that the fluid steel, congealing first on the outside of the mould, offered more resistance there to the motion of the plunger, and the outside becoming thus, comparatively speaking, porous while the fluid portion in the center received a larger amount of compression than the outside, which had more power of resisting the pressure. The particles of gas entangled within the fluid mass would therefore encounter rather less resistance toward the outside than toward the inside, the full hydraulic pressure being transmitted to the center of the fluid mass, and in that way the expulsion of the gases from the fluid metal might perhaps be accounted for.

The following explanation from Mr. F. Moro, chief engineer of the Kladno Steel Works, Austria, in reference to the consolidation of ingots compressed under the steam process, appeared in a recent number of a scientific journal:

"The liquid steel has, like other metals, *e. g.*, lead, the peculiarity of absorbing gases, and the more of them the higher the temperature. On the other hand, these absorbed gases will come out of solution on cooling, accumulating in bubbles until the rigidity of the setting steel puts an end to this. This will be the case under ordinary atmospheric pressure, but it is otherwise when liquid steel is submitted to the influence of high pressure; then the absorbed gases remain in solution, like carbonic acid in well bottled soda water, for example, and any formation of bubbles will become impossible at a pressure of over six atmospheres."

The method of steam compression described in this paper has recently been adopted at the works of Messrs. Bolckow, Vaughan & Co., and although permanent arrangements have not yet been completed, sufficient has been accomplished to confirm the statements of our transatlantic friends, and to justify the expectation that under this simple and inexpensive process, a result is gained equal to that obtained by the costly and elaborate systems of compression hitherto practiced.

* Paper read before the Iron and Steel Institute, at Liverpool.

LEAD FUME, WITH A DESCRIPTION OF A NEW PROCESS OF FUME CONDENSING.*

By A. FRENCH.

THIS paper describes a series of experiments made by the author and Messrs. H. J. Wilson and J. Wycliffe Wilson, of the Sheffield Smelting Company, with a view to discover a good process for condensing fumes of lead, silver, and other metals which volatilize in the smelting and refining operations. The loss of lead and frequently of silver by sublimation is an evil with which every smelter is familiar; not only does the loss amount to hundreds of tons of lead in a year at many works, but the injury which is done to health and vegetation is very great. It also describes a new and very successful method of condensing, whereby from 95 to 98 per cent. of the metallic contents of the smoke is saved.

The various methods of condensing fumes which have been tried in this and other countries may be classed as follows:

(*a.*) Deposition of the fume by its own gravity in long flues, with or without the addition of a series of settling chambers, placed either near to or at some distance from the furnace.

(*b.*) Filtering through flues, towers, or chambers containing brushwood, coke, coarsely woven fabric, or similar porous material, using water either in a constant or intermittent stream to keep the filters from becoming choked.

* Read before the British Association for the Advancement of Science (Section B), Sheffield, 1879.

(c.) The use of water, either in the form of steam, or in showers of drops or jets, projected with some considerable degree of force into and across the current of smoke.

(d.) Processes based on the inverse of the preceding principle, viz., passing the smoke under and through a depth of water, either in great volumes, as in the old Stagg's condenser, or in a more or less comminuted condition.

The fourth class of condensers consists of those which have for their principle the passing of the smoke through a body of water. This principle has been tried in various ways. The old Stagg's condenser, in which the smoke was drawn in great volumes under the surface of water by means of powerful pumping, is now nearly, if not altogether, obsolete.

Our experiments showed that mere bubbling the smoke through water from a perforated pipe, for example, has little effect in stopping the fume. We made experiments to prove this, both on the large and small scale. In the large one we passed the smoke through a number of horizontal perforated pipes submerged eleven inches in water. Our assays showed that only thirty per cent. of the fume was arrested. Our experiments on a smaller scale gave even worse results. The reason why simple bubbling through water succeeds no better than the shower-bath principle is, that in both cases precisely the same cause operates, viz., the surface tension of the water, which is just the same whether for a concave or convex surface of equal extent.

We can prove that fume is difficult to wet by coating a glass plate with it, and then dropping water on it while it is held at an angle of about 60° to the horizon; the drops are reflected off without wetting the plate.

This question of surface tension was well illustrated by an experiment made at the suggestion and in the presence of Mr. Alfred E. Fletcher, one of Her Majesty's inspectors. Equal quantities of smoke were bubbled through a wash-bottle arrangement, filled first with water, and then with ordinary rape oil. The oil, which has less than half the surface tension of water, caught more than three times as much fume as the water.

The considerations led us to seek for some way of destroying the surface tension of the bubbles, and we hit on the device of using fine wire gauze, made of any metal capable of resisting the corrosive action of sulphurous acid. Copper gauze answered perfectly.

In our new apparatus we use wire gauze having about 15 meshes to a lineal inch, the meshes being about 1-20th of an inch wide. A number of gauze diaphragms are arranged one above another in horizontal planes, and at small distances apart. The whole are submerged in water. The smoke is equally distributed under these by means of a horizontal series of perforated pipes. The gauze diaphragms do not add much to the resistance which the smoke current has to overcome in its passage through the apparatus. Three diaphragms of the size mentioned above add about half an inch of water pressure.

The depth of water usually employed is seven inches above the perforated pipes, and with this depth the water gauge indicates a resistance of about ten inches, half an inch only of which is due to the gauze, the remainder being due to the depth to which the smoke depresses the water at the inlet passages. The ascending gases set up an upward current of water through the gauzes, and to promote a steady circulation of this a return passage is provided.

Although we usually work with three diaphragms of wire gauze, double that number may be used without adding appreciably to the resistance, and by so doing still more perfect results may be obtained. Each square foot of area of the diaphragm space is capable of passing about forty cubic feet of smoke per minute, and when a blast furnace is employed for smelting lead ore, about one foot of area will be required for each ton of ore smelted in twenty-four hours.

During the past six months almost daily assays have been made of the smoke before it entered and after it left the condenser. These have, with a few exceptions, exceeded 95 per cent. of fume caught. The average has been 98 per cent., and in a few cases as high as 99½ per cent. of the metallic contents of the smoke has been caught. After the lead has been removed from the smoke, the large quantity of sulphurous acid which is usually contained in it may be recovered in a very simple manner. The gases can be mixed with a little air, if enough of oxygen is not already present, and then propelled by means of a steam jet through a heating apparatus similar to the hot blast heaters used in iron smelting works, and the hot sulphurous acid steam and air passed through common salt according to Hargreaves' patent process. By this means lead or copper smoke will be rendered not more pernicious than that from ordinary chimneys. Any arsenic or zinc which reaches the condenser is dissolved in the water, and in that way separated from the lead fume, which subsides to the bottom. The apparatus was tried with hydrochloric acid vapor, and condensed 97¾ per cent.; of common salt vapor it condensed 93 per cent.

We use a Roots blower, with iron revolvers for forcing the smoke through the apparatus. From 2½ to 3 horse power is amply sufficient to work a condenser large enough for a furnace to smelt 15 tons of lead ore per twenty-four hours. The weight of a condenser for that size of furnace is 18 cwt. The smoke should be cooled to about 120° to 130° F., by passing it through iron pipes or any other kind of flue. This is necessary to prevent rapid evaporation of the water with which the condenser is supplied. It is very important to cool the smoke as far as possible, so as to have a smaller volume to pass, and thereby save both power and cost of a larger apparatus.

THE NEUTRALIZATION OF PHOSPHORUS IN STEEL AND STEEL-LIKE METALS.*

By MR. RICHARD BROWN, Ayr, N.B.

As is well known to the members of the Iron and Steel Institute, the great difficulty in hitherto working up into steel the large class of ores and metals of iron in this and other countries is the large percentage of phosphorus which they contain, rendering the metals when made up into steel cold short. The aim, therefore, has been to get rid of the injurious element by elimination, but the close affinity that phosphorus has for iron has hitherto proved an almost insurmountable barrier. Some of the more recent processes are reported to have given good results, and if so, they are certainly a move in the right direction. Instead, however, of endeavoring to get rid of what I may call the great "enemy" of the steel trade, I have given my attention to the practicability of turning "the enemy into a friend," and in this respect I am glad to be able to announce that I have succeeded to the utmost of my expectations.

As is well known, the proportion of phosphorus that can at present, as a rule, be allowed to remain in steel is exceedingly small, something like 0·03 to 0·05 per cent. I am aware that larger percentages have occasionally been got, but they are the exception; whereas, by my process, I have been and am able to neutralize nearly as much as 1·5 per cent., still leaving the metal soft and malleable. I need not tell the members of the Iron and Steel Institute that in having made this achievement a very great point has been attained, which will lead to lasting benefits for the classes of ores and metals containing much phosphorus, hitherto unable to be used for steel on that account.

The agent I employ is bichromate of potash, a substance which is chemically pure, contains no water of crystallization, and is not deliquescent. It is, of course, well known that alloys of chromium and chrome ores have been used for hardening and fluxing purposes, but as a rule without success, as analyses of so called chrome steel, made by processes hitherto used, have shown that such processes have been extremely uncertain, and in many cases altogether ineffective in combining chromium with iron or steel.

With a larger proportion of phosphorus present in the metal than that given in the above example, the steel will be harder, other things remaining the same. When the proportion of phosphorus is less than that given in the example, a larger proportion of carbon may be retained, and similar results got, with a smaller proportion of bichromate of potash. Therefore, to neutralize the effects of small percentages of phosphorus, only a very small quantity of bichromate of potash will be required.

In welding chrome steel a little attention is necessary. For instance, after the pieces have been brought to the welding point, instead of striking the pieces to be welded heavily with the hammer, the smith should only tap them gently with a small hammer until the pieces are slightly welded, after which a sledge or steam hammer may be used with perfect freedom, and unless this is attended to, there is a risk that the steel may fly into small pieces if heavy hammering is used at first. By attention to this almost any kind of my steel will weld, even should it contain large percentages of carbon and phosphorus.

I herewith exhibit a number of specimens of my steel, showing some welded, some made into chisels, and some bent and twisted cold, exhibiting their different properties. Underneath is their analysis, in part also their tensile strains:

	No. 1.	
Carbon combined	1.26	per cent.
Chromium	0·25	"
Phosphorus	0·78	"

	No. 1 *a*.	No. 2 *a*.	No. 3 *a*.	No. 4 *a*.	
Carbon combined	0·190	0·180	0·230	0·200	per cent.
Chromium	0·180	0·200	0·210	0·320	"
Phosphorus	0·514	0·560	0·759	0·756	"
Tensile strain in tons per square inch	40·5	40·0	50·8	47·0	"
Ultimate extension per cent.	4·61	24·0	5·7	4·74	"

	No. 1 *b*.	No. 2 *b*.	No. 3 *b*.	No. 4 *b*.	
Carbon combined	0·30	0·30	0·52	0·41	per cent.
Chromium	0·14	0·16	0·20	0·26	"
Phosphorus	0·90	0·95	1·16	1·39	"
Tensile strain in tons per square inch	43·6	44·4	6·0	4·5	"
Ultimate extension per cent.	19·35	8·19	..	..	"

By my process, however, there is no difficulty in effecting the desired combination, as the bichromate of potash has the very important practical advantage over what has previously been used of being a convenient, expeditious, certain, and effective means of introducing the chromium into the metal, be it iron or steel.

So far as I have gone with my experiments, I have found that to neutralize three quarters per cent. of phosphorus about one-half per cent. of bichromate is sufficient. The percentage of phosphorus in "Scotch" pig-iron is something like three quarters per cent., and in that of "Cleveland" about one and a half per cent. If it is thought desirable, a mixture of the two metals, "Scotch" and "Cleveland," in the proportion of one-half of each, would give a metal containing about 1·1 per cent. of phosphorus, which again could be further reduced by the assistance of purer pig-iron or malleable iron scrap. This would lessen the quantity of bichromate to be used with "Cleveland" iron.

Another very important advantage to be gained by the neutralization of phosphorus is the important one that castings made by this process are very solid and free from blowholes or small cavities, so that steel castings can now be adapted to almost any purpose, which, to the practical engineer, machine makers, and for railway bridges is of the very utmost importance. A further important improvement consists in the fact that there is little or no loss of metal going off in the slag by this process. When the material is used the slag is of a fine gray color, showing no black oxide of iron, as I understand is usually the case by the methods at present in use; and which, I believe, amount to a very considerable percentage of loss, thereby adding to the cost of the steel. In carrying out the process in practice, nothing can be simpler. No new plant is required or alterations necessary; all that is demanded being that the little details should be gone about carefully. I have found from experience that it is the little points which, when not attended to, often cause failures, but, when well looked after, result in success.

In the Bessemer converter the bichromate of potash should be mixed with the melted metal. It may either be added by being blown in as powder by the blast, through a small hopper communicating with the pipe by a descending passage fitted with two valves, the material being first admitted into the space between the valves, and after closing the upper valve allowed to descend gradually by opening the lower valve; or the material may be introduced into the metal from the mouth of the converter, the blast being stopped during its introduction and afterward renewed for a short time in order to effect a thorough mixture. When adding the material in a reverberatory furnace or other vessel, it may be in powder or in the usual crystals, put up in small handy paper bags or other wrappers which will afford a slight protection while it is being introduced. During the time the material is being introduced, the slag must be pushed and kept aside by means of an iron rod or other instrument, and the material should be well stirred through the molten metal. When the metal is in a crucible, the cover should be kept more or less open for a short time after adding the material in order to allow of the escape of gas, and the crucible should be kept in the furnace for a short time after closing the cover. Whilst the material is being put into the converter, furnace, or crucible, and for a short time afterward, a slight ebullition takes place.

The quantity of bichromate of potash to be employed will vary in each case with the quantity of phosphorus present and the particular quality of steel desired. When the iron or metal to be operated on contains much carbon, the excess of carbon should be eliminated by means of the Bessemer converter or other adequate process before treating the metal with the material. For instance, with cast iron containing 0·75 per cent. of phosphorus and a variable quantity of carbon, the proportion of carbon should be reduced to about 0·2 per cent., and about 0·5 per cent. of bichromate should be mixed with the melted metal; this will yield a ductile steel. A larger proportion of bichromate of potash will give a harder steel. Only a portion of the phosphorus is in practice removed; but when the proportion of carbon is small, or is reduced as above directed, the phosphorus remaining in the metal no longer has an injurious action, nor imparts undesirable qualities, but, on the contrary, improves the metal, particularly by rendering it capable of being cast in a very solid condition and free from cavities or holes.

The carbon in 3 *b* and 4 *b* is in excess of what it ought to be for a large percentage of phosphorus, and accounts for the low tensile strain. That, however, was caused by the difficulty I had in decarbonizing the metal, and which would not exist with proper and efficient plant, which I did not possess. I have, therefore, hitherto worked at great disadvantage in making these and all my experiments. With the carbon decreased there would be no difficulty in increasing the percentage of phosphorus to one and a half per cent. with good results.

I may be allowed to call the attention of the members to the fact that bichromate of potash has very great softening and toughening properties, and when used in connection with a steel containing a large percentage of carbon that it increases its ductility in a remarkable manner whilst retaining its tempering properties, with the addition of being easily welded, thus rendering it most suitable for work where great tensile strength is required, such as in ship-building and railway bridges, especially bridges of large span like the one which is about to be erected across the river Forth. I exhibit a chisel marked No. 5; a piece of steel from the same material was tested, and gave the following results:

Carbon, 1·05 per cent.
Chromium, 0·27 per cent.
Breaking strain, 56·4 tons per square inch.
Extension, 4·6 per cent.

As regards phosphorus I believe there was very little present. In using a similar chisel, working with a sledge hammer, it ultimately bent to a considerable angle, and was afterwards hammered back cold.

* Read before the Iron and Steel Institute.

THE AZOIC COLORING MATTERS.

AMONG all the branches of chemistry the industry of tinctorial matters is that which advances most rapidly and presents us most frequently with useful and interesting discoveries.

To follow all these evolutions and revolutions is a difficult task which has overwhelmed many of those who have undertaken to lay this special literature before the consumer whom it interests.

After the discovery of Paris violets, of methyl greens, and of the resorcine colors, brighter coloring matters could scarcely be hoped for. Chemists in search of novelties had therefore to turn their inquiries in a new direction.

Fashion, moreover, threw itself with eagerness upon the shades of brown, maroon, garnet, olive bronze, etc., which are obtained by combining red, yellow, and blue. Hence the object became to find advantageous substitutes for turmeric, berries, fustic, orchil, etc.

The first great step in this direction was effected by the firm of Poirrier, and their scientific adviser, M. Roussin, by the discovery and manufacture of those beautiful azoic bodies known to dyers as orange, chrysoine, rocceline, etc.

The *oranges* are obtained by the reaction of the diazoic derivatives of sulphanilic acid, and of sulpho-conjugated naphthylamine upon the phenols and the amines. These matters being at once red and yellow, and behaving like all the colors used in an acid flot, immediately took their place in practice and have been of great utility. Orange No. 1 serves instead of orchil and turmeric, and serves to produce with extract of indigo upon wool, and with the aniline blues upon silk, a great variety of brown and maroon shades. It is chiefly employed upon wool.

Orange No. 2 is the brightest and resists light best. It is in great demand for silks, where it serves to obtain many compound shades, maroons, browns, grays, salmons, as also mandarines and capucines. It is also used upon wool in many cases, especially to give yellowness to scarlets, and in compound shades where brightness is required. A certain number of dyers use orange No. 2 successfully in cotton dyeing in conjunction with archil, and obtain magnificent scarlets and ponceaus. It is also of great value in dyeing leather, skins, and feathers.

Orange No. 4, owing to its great tinctorial power, is an advantageous substitute for turmeric, which is objectionable on account of its fugitive nature, but which has retained its footing in the dye-house by reason of its cheapness. Orange No. 4 is used on a large scale for heavy greens and olives.

Chrysoine is of a similar nature to orange No. 4, but is preferred to it when a greenish reflection is preferred. All

these orange yellow colors are consumed day by day in large quantities, and have great advantages over the product sold under the name of chrysoidine.

Rocceline is the product obtained by the reaction of the diazoic derivative of sulpho-conjugated naphthylamine upon naphthol. This product gives shades very similar to orchil, but brighter, and is in comparison very economical. It is much used at present by silk dyers, who value it for its cheapness, its beauty, and its fastness. Upon wool it renders it possible to obtain cheap garnets, for which magenta is unfit by reason of its instability. Rocceline is employed with great advantage as a substitute for orchil and cudbear for the red grounds of compound colors. If mixed with the oranges it gives a great number of red tones, such as cardinal, amaranth, etc.

French red is an intermediate product between rocceline and orange No. 2, and it is used for cheap scarlets.—*Lyons Textil.—Chemical Review.*

CARBIDES OBTAINED FROM AMERICAN PETROLEUM.

By L. PRUNIER.

THE light petroleums, if submitted to dissociation by heat, become a source of incomplete carbides of different orders, less rich in carbon than the formenic carbide, but capable, if the action of heat is sufficiently prolonged, of recombining among themselves so as to form more complex compounds. Among the incomplete carbons ethylen, propylen, butylen, and acetylen have been recognized. They are accompanied simultaneously by the ulterior products of their polymerization, or of their reciprocal combination, benzol ethyl-acetylen, or crotonyl. By a novel application of the general method of solvents the products have been fractionated according to a principle very different from that of a fractionated distillation and crystallization. In this manner each of the industrial products may be resolved into a great number of carbides, among which are anthracen, phenanthren, chrysen, pyren, chrysogen, benzerythren, etc. Solvents such as benzol, and even petroleum, if applied at a boiling heat and for a long time, fix themselves upon certain of the higher carbides, and bring them down to proportions of carbon not exceeding 94 and 95 per cent.

CHLORINE, BROMINE, AND IODINE.

By ANTONY GUYARD.

THE three bodies should exist in solution in the state of chlorides, bromides, and iodides. If wholly or partly present as chlorates, etc., they must be reduced by treatment with an excess of sulphurous acid. The mixture, acidulated with sulphurous acid, is treated with a slight excess of a mixture of bisulphite of soda and sulphate of copper. The iodine is precipitated immediately and very completely as cuprous iodide, in which state it may be directly determined with much accuracy. The results are liable to be erroneous only in presence of sulpho-cyanides—a circumstance not to be expected in practice. After filtering off the cuprous iodide the liquid is boiled with an excess of sulphuric acid until all the sulphurous acid of the sulphites has been completely expelled.

When this is effected, the liquid is introduced into a flask which communicates, by means of a bent tube, with a Will and Varrentrapp's nitrogen-tube. Into this is introduced a solution of bisulphite, or of sulphurous acid, or bisulphide of carbon, or, if it is preferred, a solution of potassium iodide, and the tube is kept in cold water. To the liquid in the tube is added a small excess of pure chromic acid, or a mixture of sulphuric acid and potassic bichromate, and the liquid is boiled until the bromine is completely expelled. It is then determined, either as bromide of silver, or by a colorimetric process, or indirectly by the volumetric determination of the iodine which it liberates. To determine the chlorine it is merely needful to reduce the excess of chromic acid by means of a sulphite, and to precipitate with silver nitrite.

M. C. LORILLEUX'S PRINTING AND LITHOGRAPHIC INKS.

Two kinds of varnish are employed in the manufacture of printing inks: the one obtained by boiling linseed oils, and the other from a mixture of resin and resin oil, the latter being chiefly used for newspapers where rapid drying is of importance. M. Lorilleux allows his linseed oil to rest for two years at a constant temperature. It is then boiled by means of hot air, at a distance from the furnaces, so as to remove every risk of fire. A mass of 2,500 kilos is boiled from twenty-four to fifty-six hours, and is stirred by a mechanical agitator. The varnish thus obtained is limpid, and flows well. The lamp-black is produced either by means of specially constructed lamps, or by the decomposition of naphthalin oils, which fall by drops into a heated retort. The gaseous products are carried off by tubes, at the end of which they are burnt under sheet-iron bells, while the black is carried off by a current of air into large chambers. It is afterward submitted to calcination. All the inks, lithographic or typographic, are submitted to a practical trial before being sent out.

NEW COLORING MATTERS.

By OTTO N. WITT.

IF the solutions of molecular quantities of meta-toluylen-diamin and nitroso-dimethyl-anilin hydrochlorate in warm water are mixed, there is formed a deep blue liquid, from which a coloring matter can be precipitated by means of salt. The substance obtained, $C_{15}H_{16}N_4HCl+H_2O$, dissolves readily with a bright blue color in cold water, alcohol, and glacial acetic acid. By the use, on the one hand, of ortho and para-toluydin, of the isomeric toluylin-diamin and xylidin, and, on the other, of nitroso-dimethyl-anilin, nitroso-phenol, and of the other known nitroso-compounds, the author has obtained a number of other new colors, with whose investigations he is now engaged.

ON CUPROUS CHLORIDE.

By M. ROSENFELD.

IT is commonly stated that this compound is converted into copper sulphate by the action of concentrated nitric acid. In the cold, however, there is no action, and even with the aid of heat very little. Partially oxidized cuprous chloride can be rendered colorless by washing in glacial acetic acid. In dilute nitric acid cuprous chloride remains colorless if light be excluded. It is exceedingly susceptible to light. The author describes certain chromates of copper, with whose further investigation he is engaged.

A NEW BASE, $C_{12}H_{12}N_2$.

By C. BÖTTINGER.

THIS base is obtained as a product of the reaction of benzol-chloride with aniline. On heating the base with mercuric chloride or with arsenic acid it is converted into a true coloring matter. In the former case the solution is first clear, and then reddens, the coloring matter being developed with a brisk reaction. The crude dye is a reddish violet.

GAGS.

OUR readers are respectfully requested not to laugh, for a gag, odd as it sounds, is no laughing matter. It is a something out of which a man of tact will often for a time make more money than a man of talent can derive from a genuine, important invention. A gag is some article possessing useful properties, dressed up in some strange disguise, and in virtue thereof sold for much more than it is really worth. But as example is better than precept, we will give a few instances of gags that have actually had in their day a very successful run, and which have faded away to give place to others. Some years ago, when the use of chrome (bichromate of potash) first became known to black dyers in the north of England, some drysalter, whose name we never learnt and is really nothing to the purpose, was seized with a happy thought. He ground up chrome to a fine powder, mixed it up with some cheap inert black matter—probably animal charcoal, which was then lower in price than it has been since—and sold the mixture in small kegs as the "new black mordant," at a higher price than the best chrome. As a matter of course this powder would dye a black if properly used along with logwood. As another matter of course it acted no better than chrome, which it really was; and as a third it was less advantageous, as the inert black matter was paid for at the price of chrome, or something higher to pay for the trouble of grinding and mixing. The most interesting feature of the affair is that certain dyers found this marvelous black mordant very much superior to chrome. Some, indeed, declared that without it they could not produce a chrome black fit to look at. Whether that was the influence of the black powder upon their imagination or was due to some other occult reason we are really unable to say. In short, the article sold extensively, and we believe that several chemical manufacturers, doubtless after a great amount of study and research, succeeded in making up this wonderful compound to the satisfaction of customers.

At last the trade was ruined by an accident. Business happened to be rather slack with a master dyer, whose foreman had been a great admirer of the black mordant. A keg of the article, which had been opened and partly used, remained in the wareroom, and was occasionally shifted to make room for other articles. Now, as all our readers are, or ought to be aware, if we mix two articles, one of much higher specific gravity than the other, and let them stand for a few weeks with merely a little occasional gentle shaking, the articles will more or less completely part company, the lighter being found at the top, and the heavier collecting at the bottom.

The owner, noticing the change, had his suspicions, and consulted an analytical chemist, who, of course, soon found out the secret, and black mordant disappeared from the market.

The next instance that we shall mention is "French borax powder." Every one knows what an admirable detergent borax is, both for manufacturing and domestic uses. But its high price did not allow of its being used for wool scouring.

One season, however, a man visited the principal markets of the textile districts who offered borax at a greatly reduced figure. It was not in crystals like the ordinary kind, and scarcely looked so handsome, hence it was to be had on such advantageous terms. But in quality it was warranted to be nothing inferior to the ordinary borax crystals which had hitherto been an almost unattainable luxury. Lots were accordingly purchased with some eagerness, and were found to have plenty of "scour" in them, though some consumers thought that it "punished" the wool somewhat severely, and left it rather rougher than borax ought to do. At last some one noticed that the borax powder did not entirely dissolve in water, but left a great proportion of a white residue.

This was collected, and proved to be lime, chiefly in the state of carbonate. Following up the clew, the French borax powder turned out to be soda ash, mixed with such a proportion of powdered quicklime that when put into boiling water as recommended a caustic soda-lye was produced. The price charged, though low for borax, was very high for what the article really was. This accordingly vanished from the market.

But of such devices there is no end, and as fast as one is "blown upon," and has to be withdrawn, another is brought forward in its place. As each of them is exceedingly lucrative while it lasts, the gag trade, when boldly pushed, is more profitable than genuine manufacturing chemistry, just as the emoluments of the quack often exceed those of the most eminent physician.

As to the morality of the system, and its effects upon the trade of the country, those are matters about which few care in these days.—*Chemical Review.*

ANÆSTHESIA UNDER PRESSURE

IN November last, M. Paul Bert, who is fast becoming a rival of Virchow himself in the distinction he is achieving in the fields of science and politics, described an interesting series of experiments on the facility and safety with which anæsthesia could be produced by administering a mixture of nitrous oxide and oxygen in an air-tight chamber, in which a pressure was maintained a little greater than that of the air; and he has communicated to a recent meeting of the Académie des Sciences some further observations, in which the subject is transferred from the domain of experiment to that of practical surgery. Commonly, to obtain anæsthesia under ordinary atmospheric pressure, it is necessary to administer pure nitrous oxide, and the gas can only be employed for operations of short duration, for asphyxia threatens the patient as soon as sensibility disappears. Hence this method has remained almost exclusively in the hands of the dentists, who have employed it with safety hundreds of thousands of times. The method proposed by M. Paul Bert, however, permits the use of this anæsthetic agent for operations of considerable duration. Two surgeons of the Paris hospitals have responded to the appeal of M. Bert to permit a trial of the method, and the object of his recent communication was to relate to the Académie the particulars of its employment in these cases. He described, first, the case of the removal of a nail by M. Labbé. The patient was a young girl twenty years of age, timid and nervous. In a closed chamber of sheet-iron the pressure of air was increased 0·17 m. (total pressure 0·92 m.) The patient lay upon a mattress, and M. Préterre applied the nose-piece of the apparatus, which he employs for the administration of pure nitrous oxide, connected with a bag containing a mixture of 85 parts of nitrous oxide and 15 of oxygen. The pulse was, before the administration, rather rapid, when suddenly, ten or fifteen seconds after the first inhalation, without any change in the pulse, respiration, or color of the skin, without any agitation or excitement, the arm became thoroughly flaccid, insensibility and muscular relaxation were complete, the cornea could be touched without winking. The operation was commenced and completed, and the dressing applied, without the least movement on the part of the patient, who kept in a calm sleep, the pulse having fallen to the normal frequency. At the end of four minutes, when the operation was over, slight contractions occurred in one arm, and then in the leg. The mouthpiece was removed, and the contractions ceased. The patient continued to sleep for thirty seconds, and then was readily awakened, and stated that she felt well and was very hungry, and remembered only a sensation of "grand bien être," produced by the first inhalations. She seemed "to mount up to the sky, which she saw blue with stars." She was able to walk, took food almost immediately, and complained of no unpleasant consequence.

The details of this case are interesting, as showing the quickness with which the anæsthesia was produced and with which it passed off—a striking difference from the effects of ether and chloroform. Much more important operations, sixteen in number, have been performed by M. Péan—three amputations of the breast, four operations upon bone, six extirpations of tumors, a resection of the infra orbital nerve, and two reductions of dislocations of the shoulder of three and four days' duration. The anæsthesia was maintained for periods varying from four to twenty-six minutes. The time occupied in producing anæsthesia varied from fifteen seconds to two minutes. Complete return of sensibility took place commonly in one minute; sometimes a slight degree of analgesia persisted for one or two minutes more. In one operation a slight accident permitted the patient to take one inspiration of the external air. She immediately began to talk, but complained of no pain. The first fresh inspiration of the gas arrested her speech instantly, and she did not, after recovery, remember the incident. The pulse and respiration were sometimes quickened at the commencement of the inhalation, but it was difficult to say how far this was due to the action of the gas. With insensibility the normal frequency was always resumed. In most cases the patients did not complain of any feeling of malaise on leaving the apparatus, and when the operation had not been of a serious character, they frequently walked and asked for food. In three cases there was some subsequent nausea, but in each of them India rubber mouth-pieces or new India-rubber bags were employed, and it is possible that the nausea should not be attributed to the nitrous oxide. A more frequent and unpleasant accident is the appearance of spasm in the limbs. M. Bert is sure, however, that this is due to the pressure under which the gas is administered being insufficient. An increase in the pressure of 0·02 m. or 0·03 m., which could always be instantly obtained, sufficed to arrest it in every case.

The excess of pressure employed varied between 0·15 m. and 0·22 m. In one case of reduction of a dislocation of three days' duration, in a dealer in alcohol, it was necessary to employ an excess of pressure of 0·26 m. before insensibility and muscular relaxation were obtained, and yet the patient spoke during almost the whole of the operation. Thus the employment of compressed air permits the modification of the dose of the agent with the greatest facility. It is a difficult thing to change the proportion of a gaseous mixture, but a very easy thing to alter the tension of the chamber, and so the dose of the anæsthetic.

M. Bert, in conclusion, maintains the superiority of his method over the compounds of hydrogen with carbon and chlorine in the following particulars: (1) by the absence of the period of initial excitement which is often so unpleasant and sometimes is even dangerous; (2) by the confidence and tranquillity which it gives to the surgeon, who is sure that the dose of the anæsthetic will not change during the operation, and that, in consequence, the patient has nothing to fear; (3) by the almost instantaneous return of complete sensibility even after twenty-six minutes of anæsthesia, so that, if it is desired, the patient may be awakened at a certain period of the operation, and immediately put to sleep again; (4) by the common absence of malaise, nausea, and vomiting, so frequent and tedious after the use of chloroform and ether; (5) and lastly, according to the experiments which have been performed upon animals and the cases in which it has been used by man, the perfect safety of the method. He believes that the material difficulties will not prevent the adoption of the method, especially since Dr. Fontaine has invented a movable chamber, which is suited to the purpose. His estimate of its relative advantages, however, must be considerably modified if we compare it, not as he does, with pure nitrous oxide, but with the mixture of nitrous oxide and ether, which Mr. Clover has found so valuable, and which possesses several of the advantages of M. Bert's method, to which the necessity for an air-tight chamber is a serious practical drawback. It is very desirable that the method should be fairly tried, and one of our scientific bodies who have the power of granting sums of money for investigation could hardly apply a grant to a better end; but the advantages of the method will have to be signal and incontestable before we can expect air-tight chambers to be introduced for operations in our large hospitals, while it is doubtful whether the procedure is capable of practical employment outside hospital walls.—*Lancet.*

CHOLERA IN JAPAN.

DR. D. B. SIMMONS, of Yokohama, writes as follows to the National Board of Health in regard to the present epidemic in Japan, under date of September 3, 1879:

The epidemic of cholera has assumed considerable proportions, having reached 100,000 cases, with a mortality of about 50 per cent. The disease was imported from China during the summer of 1877, and in that year the number of cases was between 14,000 and 15,000, with an average mortality of about 50 per cent. Though nearly dying out in the winter, it reappeared the next year, but the cases were comparatively few. It lingered principally in Osaka. This year it began quite early in the season, and Hiogo has been the principal center from which the disease has spread over the whole empire. Within the last two months it has rapidly increased until it has reached the figures above given. Strenuous efforts have been made by the government to stop its progress in every direction. A coast quarantine was established between here and Kobe, and Osaka; but, unfor-

tunately, the disease was brought here by two steamers just before this measure was put in force. There is positive evidence that if these two steamers had not arrived the disease would have at least been delayed more than a month. Hospitals are established in every part of the empire, and sanitary measures in accordance with modern scientific ideas are everywhere being carried out. Great trouble arises from the want of a proper supply of cheap disinfectants. Carbolic acid ranges from \$2 to \$2.50 per pound. I have strongly advised the use of sulphurous acid, which was largely employed at Yokohama, in 1877, under my instructions, and, I am sure, with good results.

The type of the disease is rather peculiar, so that some foreign physicians denied for some time that it was cholera. Vomiting and rice water evacuations were not seen in more than half the cases, if in so many; the stools were often yellow, or green and slimy. I have seen a large number of cases, but most of them have passed into the stage of collapse. The diarrhœa in the fatal cases is not often severe, but suppression of urine comes on early, followed by death in from eight to twenty-four hours. I have used jaborandi and thilocarpin in many cases, and have brought on the secretion of urine frequently when the cases were not too far advanced. The reaction, when produced by these drugs, seemed less likely to be followed by secondary fever than when stimulants were used.

TOXIC EFFECTS OF TEA.

AT the recent annual meeting of the American Neurological Association, held in this city, Dr. W. J. Morton read a paper with the above title, an abstract of which is given by the *Medical Record* in its report of the proceedings.

The author stated that the subject was best studied by examining that class of men, such as "tea-tasters," who habitually took tea in large amounts. It was, however, not easy to obtain extensive data concerning these persons, for they feared if the facts became known it might injure their business. Five cases, however, had been collected, and these, together with the experiments performed by the author upon himself, formed the basis of his paper. The bad effects of tea-tasting were known and recognized by the tea-tasters themselves, and few could carry on the business many years without breaking down. One tea-taster estimated that he got about half a pound of tea into his system during a day. It has been said that the symptoms from which tea-tasters suffered were due to alcohol or dyspepsia, but the facts collected showed the contrary.

The writer then gave the history of the cases referred to, and of the experiments upon himself. The following is a *resume:* First, as to the immediate effects of moderate doses, there was in the cases observed an elevation of pulse, increase of respiration, agreeable exhilaration of mind and body, a feeling of contentment and placidity, an increase of intellectual and physical vigor, with no noticeable reaction.

The immediate effects of an excessive dose were rapid elevation of pulse, marked increase of respiration to the extent of about one-third, increase of temperature, no period of exhilaration, but immediate and severe headache, dimness of vision, ringing in the ears, dullness and confusion of ideas. Following that was a severe reaction, exhaustion of mind and body, tremulousness and nervousness, and dread of impending harm, that could not be relieved by taking more tea.

The effects of continued doses were a continuance of the tremulousness, extreme susceptibility to outside impressions, constipation, diminution of urine, and marked influence on the metamorphosis of tissue as shown by the diminution in the amount of urea. Thus, in the week during which the author was taking toxic doses of tea, the amount of urine fell from 40 to 32 fluid ounces per day; and in the same time the urea fell from 591 to 422 grains per day. The sulphates, phosphates, and chlorides were increased. The result, as regarded the diminution of urea, agreed with previous experiments, but showed the influence of the tea much more strikingly. From the study of the drug's action, Dr. Morton arrived at the following conclusions:

1. That with it, as with any other potent drug, there was a proper and improper use of it.
2. That in moderation it was a mild and pleasant stimulant, followed by no harmful reaction.
3. Its continued and immoderate use led to a very serious group of symptoms, such as headache, vertigo, ringing in the ears, tremulousness, "nervousness," exhaustion of mind and body, with disinclination to mental and physical exertion, increased and irregular action of the heart, and dyspepsia.
4. The mental symptoms were not to be attributed to dyspepsia.
5. It diminished the amount of urine, and retarded the metamorphosis of tissue.
6. Many of the symptoms of immoderate tea-drinking were such as might occur without a suspicion of the real cause.

THE BEGINNINGS AND DEVELOPMENT OF LIFE.*

By PROF. EDMOND PERRIER.

THE SPONGES AND THE FORMATION OF THE ANIMAL INDIVIDUALITY.

DURING their period of activity, the beings that we have studied up to the present moment show themselves under two fundamental forms: (1) the *Amœboid* form, in which the naked protoplasm may produce over its entire surface temporary appendages (*pseudopodia*) of an essentially variable aspect; (2) the *ciliated* or *flagelliform*, in which the protoplasm (which is often contained in an envelope), stretches out into one or more long filaments—the *flagella* or *vibratile* lashes—that are alone capable thereafter of executing movements, and that keep incessantly beating the surrounding water in a rhythmical manner.

Usually, the same moner, the same protista, may take on these two forms in succession, after passing through a period of rest which, by reason of the resemblance (or even identity) that these beings exhibit to the eggs of animals, may be called the *ovular* stage. It will be remembered, in fact, that the *Protomonas*, the *Vampyrellæ*, the *Myxastra*, the *Protomyxæ*, the *Radiolarians*, and the *Myxomycetes*, after living for a certain length of time under the amœboid form, become encysted; and that, within the envelope which protects them, their substance divides into unciliated zoospores which escape from the cyst and swim about freely in the surrounding liquid. Under these two forms, several individuals may be associated to constitute colonies: for instance, the *Myxodyctia* are colonies of amœboid moners; the *Anthophysæ*, the *Codosigæ*, the *Phalansteria*, the *Dinobrya*, the *Magosphera*, the algæ of the family of *Volvocineæ*, are colonies of ciliated cells; and there are, too, compound Radiolarians and Foraminifers.

All these colonies are formed of like elements. These elements themselves are entirely independent of each other. However, in the Foraminifers and Radiolarians, as well as in

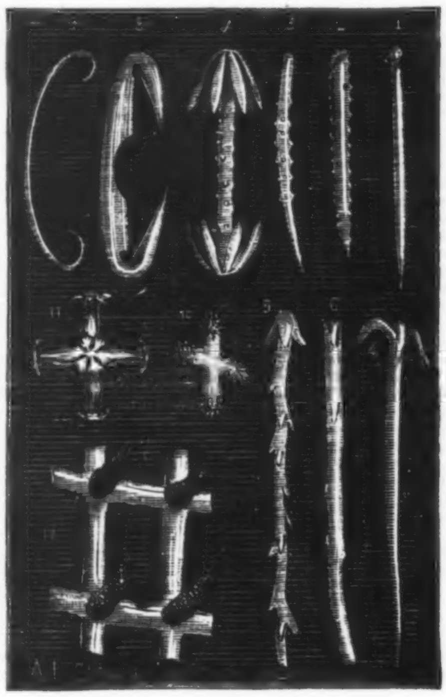


FIG. 1.—SPONGE SPICULES.

1. Pin-shaped spicule of *Hymeniacidon carnosa*. 2, 3. *Halichondria incrustans*. 4. *Tethea Collingsii*. 5, 6, 11. *Euplectella aspergillum*. 7, 10, 11. *Hyalonema mirabilis*. 8. *Hymedesmia Johnsoni*. 9. *Halichondria variantia*. 12. Silicious network of *Farrea*.

the *Volvocineæ*, they already begin to show a certain tendency to unite in an intimate way to constitute a new unity, which may be styled the *polycellular individual*. In the sponges we observe a new phenomenon: the *Amœboid cell* (Fig. 3, No. 5), and the *ciliated* or *flagelliferous cell* (Fig. 3, Nos. 2, 3, and 4), associate together to form colonies, which are consequently composed of two sorts of unicellular individuals. Moreover, these individuals are so closely related that it is no longer possible to see in them anything else than the component elements of one individual of a new species—the *sponge individual* (Fig. 1, No. 1).

We are indebted to Prof. Haeckel, of the University of Jena, for having clearly shown what must be understood by the term "individual" in sponges. Up to his time the greatest disagreement existed among naturalists. We would have a false notion of what a sponge really is, did we know but the common form—the toilet sponge. The fibrous network, which for the majority of people is the essential part of the sponge, is, on the contrary, only a sort of

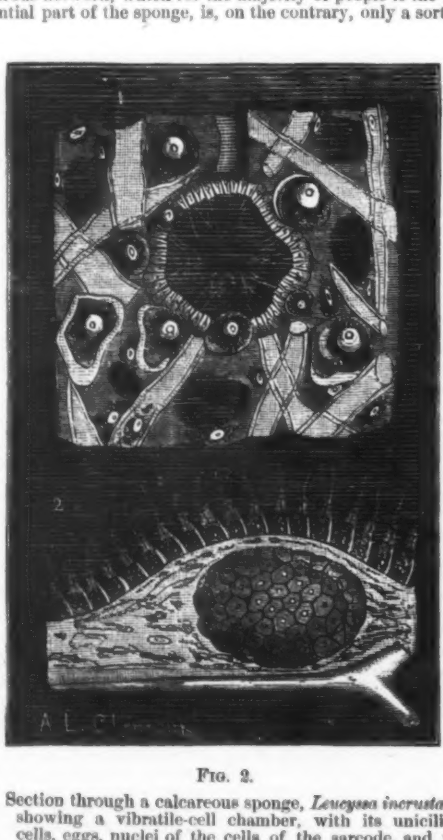


FIG. 2.

1. Section through a calcareous sponge, *Leucyssa incrustans*, showing a vibratile-cell chamber, with its uniciliate cells, eggs, nuclei of the cells of the sarcode, and the envelopes of the spicules. 2. Portion of a calcareous sponge, *Sycandra compressa*, showing the layers of the flagellate cells, and, underneath, an embryo in process of development.

skeleton designed to support the fleshy mass of one of the most singular of organisms, and whose form and principal anatomical peculiarities it pretty faithfully reproduces. The chemical composition of the fibers of this skeleton closely approaches that of silk. In certain sponges there are associated with the fibrous network silicious productions, with clearly defined forms, called *spicules*. In the majority of cases the fibers are wanting, and the skeleton is then formed entirely of these spicules, the extremely varied forms of which are often very elegant, as will be seen by the accompanying figure (Fig. 1). Here we see pins, hooks, anchors, three-rayed stars, starry-headed nails, crosses, etc. Some-

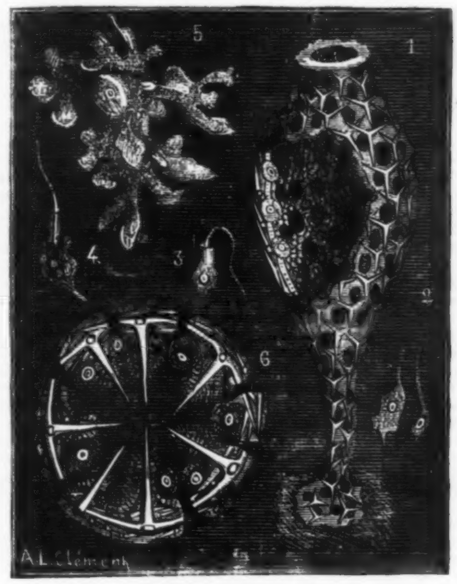


FIG. 3.—CALCAREOUS SPONGES.

1. *Olynthus primordialis*, Haeckel, type of the sponge individual. 2. Male elements of the same. 3, 4. Flagellate cells of the same. 5. Amœboid cell considered as an egg. 6. Transverse section of an *Ascaltis Gegenbauri*, showing the amœboid layer, the spicules, the eggs, and the layer of flagellate cells.

times these spicules are silicious, sometimes they are calcareous, and then their forms are quite simple. Here again we see protoplasm manifesting different chemical tendencies, but which are exactly of the same rank as those already known to us: the solid matters which are deposited in its substance are of three sorts—either of an organic nature, or silicious or calcareous. Calcareous and silicious spicules never coexist in the same sponge, so the chemical composition of the spicules really indicates here a fundamental difference in the properties of protoplasm; and this is a point upon which we have already dwelt in speaking of the Foraminifers and Radiolarians. Admitting the theory of descent, we might then ask whether sponges with calcareous spicules, or, more briefly speaking, whether *calcareous* and *silicious sponges* have not descended from different protista which had a parallel development. There would be at most, in this hypothesis, a collateral relationship among them. Certain sponges entirely deprived of skeleton ought then, perhaps, to form a special group, and such are called *Myxospongia*, or gelatinous sponges. The fibers and spicules of sponges have been studied with extreme care, and they have been looked to as distinctive characters for genera and species; but they are merely accessory parts, the essential portion being the fleshy mass in which they are developed—a mass full of canals branching in various directions, and ending in

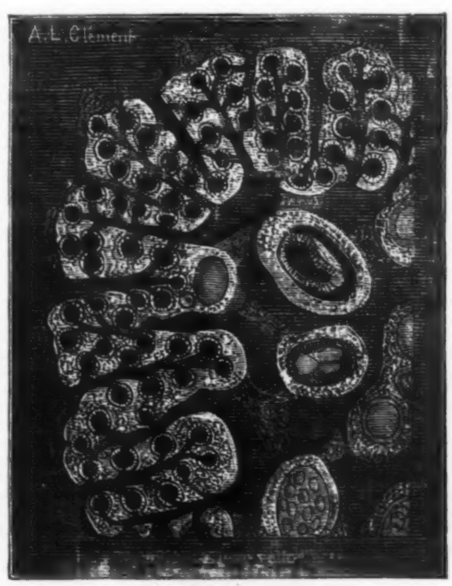


FIG. 4.

Section through a gelatinous sponge, *Halisarca lobularis*, showing the system of cell chambers in the small canals. The central cavity corresponds with the osculum. In the substance of the fleshy columns that traverse it are seen embryos in different stages of development.

external orifices which may be readily seen on examining a toilet sponge. An examination will show that these pores are of two kinds: one kind, the *oscula*, are scattered here

* From *La Nature*.

and there, and are large enough to receive the end of one's finger; and the other, the *pores*, are exceedingly numerous and of small diameter. In fresh water there are quite frequently found two little silicious sponges—*Spongilla lacustris* and *S. fluviatilis*—the pores and oscula of which are quite visible. Let them be placed in a vessel of water in which some powdered indigo or carmine is held in suspension, and it will not be long before it is seen by the movements of particles of colored powder that a current of water is continuously penetrating the substance of the sponge through the inhaling pores, and that this water is thrown out again through the oscula. The inhaling pores, then, seem to be thousands of little mouths which are constantly open, and through which penetrates the water loaded with alimentary substances. The oscula serve as discharging orifices. We will readily understand how the current of water which traverses the sponges is maintained by casting our eyes on Fig. 4, which represents a transverse section of a gelatinous sponge—*Halisarca lobularis*. In this figure we see: (1) large central lacunæ, which form part of a vast cavity corresponding with one of the oscula; and (2) an entire system of canals starting from the periphery of the sponge, and all ending at the central cavity. The exterior orifices of these canals are nothing else than *inhaling* pores. The smallest of these canals almost always exhibit in their passages a spherical enlargement lined with cells, each of which is furnished with a flagellum (Figs. 2 and 4). The movement of the lashes prevents the water from remaining in the cavities, and keeps driving it in the same direction; this is the cause of the current spoken of above.

Carter, who discovered these cell chambers and contents, saw therein the fundamental part of the sponge, the organism, the individual upon which all the other parts are mere dependencies. To him sponges appeared to be something like colonies of *Volvox*. The majority of sponges should, in fact, be regarded as colonies. Every osculum is the center of a particular system of canals and cavities, which, in the sponge, constitutes a domain, and the limits of which are more or less clearly traced. Sometimes there is an absolute continuity between two neighboring domains; but sometimes also there is a complete separation, and finally a number of sponges are known which never possess but one osculum. The latter should evidently be called *simple sponges* in contradistinction to those having multiple oscula.

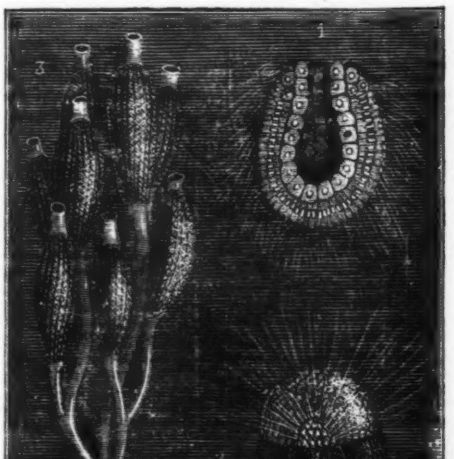


FIG. 5.—CALCAREOUS SPONGES.

1. Larva or gastrula of *Olynthus armatus*, after Haeckel.
2. Larva of *Sycandra raphanus*, after F. E. Schulze.
3. Colony of *Sycandra ampulla*, Haeckel.

These simple sponges with a single osculum, to which Haeckel has properly directed attention, furnish us with the type of what must be considered the individual in this class of organisms. The most important form to illustrate this is the one which Haeckel has called *Olynthus* (Fig. 3, No. 1). The typical *Olynthus* is urn-shaped, and its opening is nothing else than the osculum of the sponge. Its delicate walls, which are supported by tri-radiate calcareous spicules, are quite regularly perforated with holes. These holes may be temporarily closed; and it sometimes even happens that they all close at once. The walls of the urn are composed of two very distinct layers of tissue, the internal one being formed of cells which are each furnished with a flagellum surrounded at its base by a membranous collar (Fig. 3, Nos. 3 and 4, and Fig. 2, No. 2). The interior cavity of the urn, then, communicates with the exterior only through the osculum. These cells are identical with those which compose the cell-chambers of the compound sponges; so the entire cavity of an *Olynthus* may be considered as forming only one great flagellate-cell chamber.

We cannot fail to be struck by the absolute resemblance of the flagelliferous cells of sponges with the *Salpingœca*, or with the individuals which go to form colonies of *Anthophysa* or of *Codosiga*, of which we have hitherto spoken. The nucleus, the nucleolus, the contractile vesicle, the collar which surrounds the flagellum, all concur in establishing a fundamental identity with these little beings. For this reason, an American naturalist, Mr. James Clark, has proposed to consider sponges as colonies of flagellate Infusoria—*Colonies of Monads*. Taking into consideration only the external layer, other naturalists had been led in a similar way to regard sponges as *colonies of Amœbæ*. It is in truth impossible to distinguish clearly defined cells in this layer, but we do see numerous nuclei indicating its cellular origin; and, when any part whatever of its substance comes to be isolated, this part begins to execute amœboid movements of the greatest distinctness. This is such a striking peculiarity that, for a long time, numerous authors (among whom may be cited Dujardin, Carter before the discovery of vibratile chambers, Carpenter, Gegenbauer, etc.) placed sponges at the side of the Rhizopods. The diversity of these opinions ought to be a lesson to us. It is no more allowable to say that sponges are colonies of Amœbæ or of flagellate Infusoria, than it is to say that a house is an assemblage of stones or an assemblage of pieces of wood. The house once constructed forms a new object worthy of a special denomination, and which is no longer sufficiently well defined by the names of the materials of which it is built, because these materials are thereafter united in a definite manner and for a particular purpose. It is none the less true, however, that having taken their place in the collection which compose the house, these materials preserve their own character entirely. Just so with the elements of a sponge. Each of them remains comparable to a flagellate Infusoria or to an Amœba; each of them preserves to a higher degree its individuality, lives on its own account, and in its own special manner; but all of these organisms are under the sway of a special law which causes them to concur in maintaining the existence and prosperity of a new individuality of a superior order of unity—the simple sponge, the *Olynthus*. Each of these component elements of the sponge has, moreover, risen above its primitive condition of unicellular organism. It bears within itself a force of evolution which leads it, as soon as it is isolated, to reproduce the individual of which it formed a part. It is no longer made to live alone, independent; it is then incomplete, and the whole reproductive effort in it tends to reconstitute the complex society that we have just learned to know. This tendency is taken advantage of in the reproduction of species among the *spongillæ* and the different marine sponges, almost the entire mass of which breaks up at certain seasons into little protoplasmic spherules, which are enveloped in a cyst supported by spicules of a particular form. At a certain period the protoplasm escapes from the cyst through an orifice formed for this purpose, and, after having moved about for a certain length of time like an Amœba, it becomes transformed into a sponge. Sponges have another mode of reproduction, which is more general and perhaps also more instructive. In their structure, probably in the Amœboid layer, there appear large cells very distinct from the surrounding tissues, and provided with a beautiful nucleus and a nucleolus (Fig. 2, No. 1). These cells have no enveloping membrane, and when they are isolated their outline exhibits all the modifications of form which characterizes the movements of the Amœbæ (Fig. 3, No. 5). They should be considered as true eggs, and so much the more so because the male element seems to be represented in sponges by other cells furnished with a flagellum and resulting perhaps from a modification of ordinary flagelliferous cells, from which they hardly differ except in size (Fig. 3, Nos. 2 and 6). Fecundation has not been observed so that we may know positively in what it consists; but it is none the less certain that the large ovular cells are not long in dividing into 2, 4, 8, 16, 32, or even more cells, in the very mass of the sponge, and in becoming transformed into a small spherical mass which is hollow and composed of cells exactly like one another, and all like the cells from whence they were derived by a successive series of subdivisions, each equivalent consequently to an Amœba. The young sponge at this moment is really only a colony of Amœbæ. But soon the cells of one of the halves of the sphere lengthen out, produce a flagellum, and, in a word, transform themselves into flagellate cells, as we have seen amœboid cells of *Magosphæra* do. The embryo is thereafter a colony composed of amœbæ and monads (Fig. 5, No. 2). The latter play the part of locomotor individuals in the colony. The embryo may swim freely in the surrounding liquid. It is, moreover, exactly comparable with the embryos of the superior animals, and, like them, represents a distinct individual; but the history of the development of such an individual teaches us that it results, in its turn, from the union of elements which, as regards their structure and mode of formation, are exactly identical with the unicellular beings that we have hitherto studied, and to which we could not refuse the quality of individuals. In the history of the sponges there is but one new fact, and that is that these elementary individuals, instead of separating in measure as they are formed, remain united; and, moreover, their reciprocal independence, as we have seen, is yet great enough to have allowed experienced scientists to see in them the true individuals whose immediate association forms the sponge without passing through other intermediate ones.

To sum up, the sponges do not differ in this respect from the higher organisms. A whole science, that of Histology, rests on this fact, that animals of every rank are associations of elements analogous to those that are exhibited to us in the sponges, but only of more varied forms; and it has for its object the determination of these elements and the study of their properties. It proclaims this truth, which was such a fecund source of discoveries for Claude Bernard, viz., that even in the most complex and highly individualized organisms, the histological elements still preserve their independence, behave like beings very distinct from one another, and temporarily associated for a common work. Man himself is only a colony of this kind, but it has taken many marches to arrive at his construction, and we shall have to see how these marches have been accomplished.

(To be Continued.)

THE LICK OBSERVATORY.

DURING the last four years, very little has been heard of the observatory to be built in California from the gift of Mr. James Lick, and the public has very generally supposed that nothing would come of the project. But there are now signs of a renewed activity on the part of the trustees, and evidence of an intention to carry the project through without further delay.

In August last, Mr. S. W. Burnham, of Chicago, the well-known observer of double stars, was invited to spend a month or two on Mount Hamilton, with his telescope, in order to test the suitability of the mountain as a site for the proposed observatory. His reports were so favorable that Professor Newcomb, on whose recommendation he was chosen for the work, visited the place himself in September. Both these gentlemen speak in the highest terms of the excellence of the astronomical conditions. Not only is almost every night perfectly clear, but, according to Mr. Burnham, bad seeing is almost unknown. Every night is such a one as he would consider superb at Chicago, and would only meet with two or three times a year. He discovered during his stay a number of new double stars, in portions of the sky which are further south than can be thoroughly examined in the comparatively bad atmosphere of stations this side of the Mississippi.

The result of this exploration will give both the trustees and the public a new interest in the project, and it is supposed will lead the former to push the work on as rapidly as possible. If, as both the astronomers who have examined the site seem to suppose, its atmosphere is finer than that of any existing observatory, the result will be that the most powerful telescope in the world will be under the finest sky for employing its utmost capacity.—*Science News.*

NORDENSKJÖLD'S WINTER EXPERIENCE AND OBSERVATIONS.

WHILE in Japan, Professor Nordenskjöld, the successful Arctic explorer, gave to a correspondent of the New York *Herald* an extended account of his winter's work, and his expectations as to the commercial result of the new Northeast passage. However much the latter may be overestimated by the naturally enthusiastic explorer, his story as outlined below is decidedly interesting.

It was on the 28th of September, 1878, that the further progress of the Vega, whose course had been very slow for several days previously, was finally arrested and imprisoned by the ice, and so compelled to take up her winter quarters. Two days more of open weather and sea and she would have entered Behring Strait and reached Yokohama ten months before she did. Her voyage, however, was delayed by the observations which had to be taken in various places, as well as by the occasional ice encountered, and thus it happened that foreign communities were long in suspense as to the fate of the investigators. Meanwhile these were located, in what comfort can be attained in Arctic regions, on the east side of Koljutschein Bay, one mile from shore, in latitude 67° 7 min. north, longitude 173½° west from Greenwich.

The time passed without extraordinary incident until the date of the release of the ship, on the 18th day of July according to Asiatic, the 17th according to American time. As a rule the cold was intense during the winter months. Northwesterly winds, often amounting to storms, were very constant. At rare intervals mild weather was experienced. For instance, on one day in February the temperature was some degrees above freezing point. Sometimes the breeze would come from the southward, and then there were numerous openings in the ice, but all far from the steamer, which thus had no chance of escaping. Snowstorms were of almost continual occurrence, and offered a peculiar feature. The flakes never melted enough to be subsequently frozen together in fields, as in the case in Scandinavia and Northern America. Thus it can easily be conceived that, with the prevailing strong gales, enormous masses of snow were nearly always in motion. Hence tremendous drifts were formed on the ice and ashore, and exploring excursions were rendered both difficult and dangerous. During the whole of their sojourn our friends were on terms of amity and cordial intercourse with a happy, peaceful, and interesting people, their indigenous neighbors of the mainland.

THE TSCHUKTSCHI.

These are known as the Tschuktschi (I give Nordenskjöld's literation). The ship was a constant rendezvous for them. The professor speaks of them as savages, inasmuch as their civilization is not very far advanced, but he is enthusiastic in his testimony to their excellent qualities—social, domestic, and national. They do quite an extensive trade between Siberia and America, being locally within easy reach of many points in Alaskan territory, which is accessible to them both in winter and summer—in the former season by a solid bridge of ice, in the latter by the open sea. They employ sledges drawn by dogs, of which animals the explorers do not speak very highly. This season, perhaps, may have been an exceptionally severe one for both man and beast in the particular portion of Northern Siberia where the party wintered. Nordenskjöld says that dogs were plentiful, but they were mostly weak and ailing from hunger, their masters often being unable to supply them with sufficient food. In this connection it is worth while to record that so high an authority as the great navigator does not think the services of dogs in Arctic exploration very valuable. They are apt to be sick and feeble, and their nourishment is always a matter of some difficulty. During the warm months the Tschuktschi make their trips to and from the American shore in skin boats, which, from the description given of them, I judge must have a striking resemblance to the old Celtic corracle or curragh. The more genial period and the water route are most favored by these Siberian peddlers for their excursions. When they travel over the ice parties of four, five, or six traders will use one sledge, which has twenty or thirty dogs to drag it. Their commerce consists of the furs which they bring from America to the other continent, where they barter them with the Russians for simple commodities. Reindeer skins are also an article of their exchange.

"HARD TIMES" IN THE ARCTIC.

I have alluded to the probability of the year having been an exceptionally bad one. There certainly appears to have been a kind of famine last winter among these generous people. Many of them passed the ship on their travels, or simply came to see her out of curiosity. In every case they went on board to eat, as of right. The Swedish commander distributed as much as three thousand pounds of bread among these guests, who evinced a heartfelt gratitude for the bounty. They are described as distinctly differing from the Esquimau tribes; and though it is not yet decided to what race they belong, they are thought to be related to the Kamtchatkadales and Koriaks.

A NATION OUT OF THE WAR BUSINESS.

Some very interesting and valuable details have been collected by Nordenskjöld and his staff as to their ethnography and history. About two hundred and fifty years ago they were distinguished and gallant warriors. The discoverers have gathered a valuable assortment of the arms and armor of that period. Many of these implements are preserved among the families, whose habits are no longer aggressive. Very noticeable are their cuirasses, carefully wrought out of mammoth ivory, and fashioned with a remarkable resemblance to the old Roman panoply. Their spears and bows are made of whalebone, wood, and ivory, spliced and bound with the sinews of the reindeer, and showing an advanced perception of artistic ornamentation on the part of the makers. One hundred and fifty years ago the famous Russian, Col. Paulovski, commanded an expedition sent against them from Siberian settlements. In his first engagement with them he was badly worsted. He subsequently defeated them, but with heavy loss to his own troops, and has recorded much such a tribute to their valor as Pyrrhus bestowed upon the Italian legions which he overthrew. A mild form of disease is averred by the natives to have been left behind by his soldiery and to be still in existence.

NO GOVERNMENT AND NONE WANTED.

At present the Tschuktschi are held to pay to Russia a small tribute, which is collected in the form of trifling dues

for permission to trade in the marts of Nischni-ko-lymsk and Anadyr. In spite of this, however, they admit of no allegiance, and not one of those interrogated appeared to have any knowledge of the existence of a Czar at St. Petersburg. Strangely enough they have no government, no laws, and almost no religion, if any. A Russian starost is their nominal ruler, but has neither authority nor influence. In fact, there seems to be no necessity for the exercise of either the one or the other, for his subjects are evidently an exceptionally excellent and well-disposed people. The foreigners were on terms of intimacy with thousands of them, and never saw or heard of a single case of quarreling among them. Perfect harmony prevailed in the villages and families. Women have great influence, and are treated by the men in all respects as their equals and with much politeness and deference. The language spoken by this tribe is peculiar, and, as far as has been yet determined, shows no affinity to others. On this subject, however, it is yet too early to speak with certainty. Lieutenant Nordqvist, of the Russian Imperial Guards, one of the specialists of the expedition, has formed a very large collection of their vocabulary and idioms, and when his work has been examined by philologists it is certain much interesting light will be thrown upon this branch of the subject, and will help to determine to what section of the human family the people belong. Probably they will be found to pertain to some Polar-Mongolian or Polar-Caucasian race.

HANDSOME SAVAGES.

The features are less Mongolian in type than are those of the Esquimaux or the other indigenous tribes of Siberia. The hair is generally, but not invariably, black, and the complexion is decidedly light. Young women are often very fair, handsome, and of perfect symmetry and fine proportions. The men are tall, above the average height of man's growth, some of them attaining to very little short of the splendid stature of the best specimens of humanity in Northern Europe. One woman is mentioned to me as being of gigantic size, so large, in fact, that she might well be shown for money. One of Nordenskjöld's attachés has a note—I regret at this moment inaccessible to me—of her height and bulk, the former being over seven feet.

THEIR DIETARY.

Kjellman, the able botanist and old companion of the commander of the party in former Arctic travels, conducted the necessary researches into the dietary as well as of all the flora of the district, and has compiled matter enough to form a very valuable and elaborate treatise on his return to Europe. He finds that the Tschuktschi are omnivorous. They subsist upon the meat of reindeer, bears, and seals, and fish and vegetables, a fact the more important to be noted, as they have hitherto been cited as one of the few races that are exclusively animal eaters. During their brief summer they collect a quantity of vegetable food and store it for winter use. A dainty with them is the stomach of the reindeer, killed when the beast has fed to repletion. The belly and the herbage it contains are cooked together and eaten with great relish. A similar custom to this prevails among the Esquimaux, whom Nordenskjöld's friends do not much resemble in face or feature. Nevertheless there are striking points of likeness in the dress, boats, arms, and utensils of the two peoples. During the Vega's long stay no deaths and only two or three births occurred among the Tschuktschi.

HOW THEY COUNT.

It is a matter of considerable difficulty to estimate their ages with any approach to accuracy, as their idea of numbers is very vague, apparently not extending beyond eight or ten numerals. Thus, if they wish to express five they hold up one hand, with the fingers spread out; ten they represent by two hands, twenty with the hands and feet, and if their calculation goes beyond that a second individual is called to aid in the demonstration of numbers between twenty and forty. It will be apparent from this that the age of individuals is not carefully recorded or remembered, but some of the people had evidently attained an extreme age. Little more, so far, remains to say about them or their mode of life, except that they possess a few guns among them, are familiar with gunpowder, and have in use some American axes, knives, and pots. Very little foreign clothing is employed by them, their vestments being almost exclusively of skin. The nation probably numbers ten thousand souls, of whom one half inhabit the littoral between Tschaun Bay and Behring Strait, and the other half dwell in the interior of the country.

TRUE ARCADIANS.

Although the deck of the Vega contained numbers of them, from eight o'clock in the morning till six at night daily during her stay, nothing was stolen. When desired to leave the visitors departed. On the whole it is impossible to imagine a more Arcadian race, though no philosopher has yet expected to discover Arcadia so near the North Pole. A people without chiefs and without criminals, experiencing no difficulty in the distribution of the product of their joint exertions in fishing or hunting, whose sole sign of pride of wealth or fancy is the possession of a boat a little larger than ordinary, may well deserve the respect they have earned from Nordenskjöld and his party, and prove fitting subjects for further ethnological study.

THE LIFE OF THE EXPLORERS.

The months of March, April, and May were very cold. In June the temperature became more supportable, though even until the middle of the latter month there was no sign of liquefaction in the snow, which, however, had much diminished and continued to diminish in bulk by evaporation. Of course the most careful observations of all possible kinds were taken constantly during the time of the Vega's detention. An hourly meteorological record was kept by Lieutenant Hovgard, of the Danish navy, who also occupied himself with magnetic studies.

A HINT FROM THE TIDES.

Captain Palander, the second in command of the expedition, and master of the discovery vessel, busied himself with the movements of the tides. From his memoranda his chief has made the deduction that, as tidal rise and fall are very insignificant, the sea north of Behring Strait must be small, and is probably circumscribed by islands between Wrangel Land (seen by Long, the American whaler) and the Franklin archipelago north of America.

THE METEOROLOGICAL WATCH.

Barometric, thermometric, and other physical observations were taken on shore in an observatory specially erected for the purpose, where a splendid passage instrument, belonging to the Academy of Science at Stockholm and lent to the expedition, had been set up. Here on constant duty were one of the officers and two of the crew of the Vega. Their task was mentally hardly a light or corporeally a pleasant one. Each watch was of six hours. Those on duty occupied an hour in going from and returning to the ship in a temperature almost always at least forty degrees below zero, Fahrenheit, and had to remain for five hours virtually motionless in a house where the thermometer marked an average of five degrees below zero.

NO SICKNESS.

The trial involved in this work was necessarily a severe one; but no one complained and no one suffered in health. No sickness occurred on board, and not a trace of scurvy ever manifested itself. Good provisions and good discipline may, no doubt, be largely thanked for this, although much is doubtless owing to the superior physique of the members of the expedition. These are all picked men, most of them below thirty-five years of age, only one or two are a trifle older than their illustrious leader, who is forty-six years of age. A little fresh meat—bear and reindeer—was procured by hunting, or from the friendly natives during the severest months. There were also some hares and ptarmigan, but scarce and hard to get. As spring advanced game became more plentiful, and at last flights of birds, in dense and numerous masses, came and provided sport and food for the explorers.

BIOLOGICAL STUDIES.

Nordenskjöld, with his vast experience of Arctic regions, had supposed, before leaving Sweden, that the ornis of Northern Siberia would closely resemble that of North Greenland and Spitzbergen. He actually found it, however, poorer in specimens, but much richer in kinds, and possessing several forms not known before. Many of the birds are supposed to winter in Japan and not very northern parts of North America. Lieutenant Nordqvist had the special task of collecting and examining them. He takes home a large assortment, the classification and adjustment of which are expected to be of special interest in accounting for the relation of the fauna of America and Siberia. While the voyage lasted extensive dredgings were made in the sub-Arctic Sea by the naturalist, Dr. Stuxberg, who was charged with the investigation of the invertebrate forms to be met with. Aided by an excellent apparatus he was enabled to discover that waters previously supposed to be almost devoid of animal life are really remarkably rich in that respect. He has already sent to the Academy of Science in Stockholm a prefatory memoir on this subject. He has numerous specimens of crustacea, echinodermata, and crinoida, some of extraordinary size and many before unknown. Botanical investigations were conducted by Drs. Kjellman and Almqvist, the former being specially busied in inquiries into the algæ and flowering plants of the regions visited. At the time the party left Sweden not one single specimen of algæ was known to science as having a habitat between the Kara Sea and Behring Strait, and a general notion obtained that none existed. Kjellman examined the bottom of the sea in a number of places, and found that, though comparatively poor, it still contained no insignificant number of species. Those procured in the western sea correspond with European algine flora; those to the east with Pacific kinds. In Behring Sea the zoological and botanical researches were continued, with the result that Stuxberg collected a large number of invertebrata, while Kjellman was equally fortunate in his additions to his store of algæ, finding many large and beautiful specimens in waters before deemed to be without such kinds of life.

ARCTIC FLORA.

Indeed, no very correct knowledge of these regions was available before the explorations of Dall, the American scientist. No more accurate notions were entertained on the subject of the phanerogamic fauna of North Siberian lands, of which tracts the eminent Russian naturalist, Middendorff, says that they are "almost as destitute of higher species of plants as is the Antarctic continent," and that "on the eastern shore nothing but mosses and lichens, and those few in number, are to be met with." Already the investigations made by the English and American Franklin expeditions have proved that this estimate was not accurate. Now Kjellman brings us the additional intelligence that the whole coast, with the exception of a few barren intersections, is covered with glowing vegetable life. He has made a collection of more than one hundred and fifty specimens, whereof twenty-three were procured on Cape Tschuktschi, or close to the extreme eastern point of Asia. South of Behring Strait the vegetation was most luxuriant and much mixed with more southern forms. In places the soil was literally covered with flowers, so as to resemble nothing more than a gorgeous Brussels carpet. Greater luxuriance could seldom be found in tropical countries. Dr. Almqvist's accumulation of lichens, which he found in vast quantities in the north, but less multitudinous in more southerly directions, will enable him to describe justly all the lichenography of Northern Siberia. Unfortunately, the resources of the expedition did not permit of the services of a specialist for mosses being attached to it. Nevertheless a number of specimens of this division of cryptogamia were gathered and will be classified.

SEA TEMPERATURE.

The hydrographic department was under the control of Lieutenant Bove, a talented young officer of the Italian navy, who has enriched the work of the party by important annotations. It must be remembered that he had to take notice of the phenomena apparent in a sea between Yenisei and Wrangel Land, never before traversed by any ship. He found the surface temperature of the water extremely variable. It was tolerably high near the mouths of the large rivers, which empty their comparatively tepid floods into the silent and frozen sea. Sometimes the surface liquid was so fresh that it was palatable to drink. A fathom or two deeper it might be intensely salt and cold, and then the bottom water would be temperate or even warm by contrast, registering as little as two centigrade degrees below the freezing point. It was found that water from the surface bottled and sunk to the bottom would freeze there, and that it had the effect of a deadly poison upon the living forms which move in regions immediately below it.

A THEORY OF THE AURORA.

While his subordinates were thus busy the master himself was superintending and arranging the results of their toil. His special attention was, besides, devoted to the observation and registration of auroral phenomena. He announces that the year of his captivity was a minimum one of such appearances and sun spots. Throughout the winter he did not once observe that the Northern Lights attained the magnificent development acquired by them in Scandinavia. But whenever the sky was clear, and there was no sun or moon, he saw, constant in the northeast horizon, and almost always in the same exact spot, a faintly luminous arc so motionless as to be susceptible of accurate measurement. This phenomenon, Nordenskjöld concludes, comes from an actual aureole, or ring of light, surrounding the northern portion of the globe. Its center should be the spot where Hall wintered, and its radius about 8°. The Swede opines that it girds the whole of North America with an enduring glory.

FREE FROM THE ICE AT LAST.

Up to near the middle of last June the weather was still cold, below freezing point, the snow continuing to evaporate so rapidly that little of it was left. On the 14th there was a sudden change to milder weather. A heavy thaw set in, and the coast land was so covered with mud and slush that all excursions had to be discontinued. The ice which bound the ship, however, was still so strong that the explorers did not hope to be able to leave before August. Throughout their stay there had been open water seaward, but far from the ship. On the 16th and 17th of July an opening manifested itself along shore, but the ice was still tenacious of its prisoner. So Nordenskjöld determined to take the steam launch to the sea, embark and visit some whaling ships reported by the natives to be near Behring Strait. By half-past one in the afternoon, when his preparations were almost completed, the ice which inclosed the Vega began to move. An hour later Captain Palander, who was prepared for every emergency, had steam up. At half-past three the ship was free, steamed a short distance westward to clear the floe, soon set her prow in the right direction, and experienced no further obstruction from ice in the Siberian Sea.

"STEAMING ALONG LIKE A LORD."

On the 20th the East Cape of Asia was passed in foggy weather, and saluted with flags and a Swedish salvo of three guns. Behring Strait was quickly entered, and the ship made good way to St. Lawrence Bay, at the mouth of which, as it was full of ice, anchor was dropped. After what time was necessary had been devoted to scientific observations, and a visit had been paid to a neighboring Tschuktschi village, the vessel proceeded to Port Clarence, on the American side of the Strait, for the purpose of permitting comparison of its flora with that of Northeastern Asia. Here some Northwestern Esquimaux were encountered. They are quite distinct from the Tschuktschi, with whom, however, they seem to have been confounded by some English writers.

THE ESQUIMAUX.

The modes of life of the two people are similar. The American Esquimaux were very good to our travelers, who exchanged with them their winter stock of clothes against a valuable ethnological collection. Members of the tribe possessed Remington guns, which were in striking contrast with their stone weapons. A curious habit of ornamentation exists among these people; they make holes in the lip on each side of the mouth big enough to pass a finger through, and wear in them carved pieces of bone or stone, some showing a high degree of skilled workmanship. It seems now that this custom is giving place to the European one of wearing earrings. Higher esteem is bestowed by these Esquimaux upon money than the Tschuktschi accord to it. A few tribes of the latter are said to be living on the American continent further north than Port Clarence. From this latter point the Vega went to the Asiatic coast and entered Sencaven's Sound, south of St. Lawrence Bay, which was still choked with ice. A good chart of this locality was drawn up by Admiral Rodgers, United States Navy, and found of much utility by Nordenskjöld. The coast at Leneaven was found uninhabited, except by two Tschuktschi families, with reindeer. A little distance inland there are high mountains, mostly volcanic and plutonic, and the flora of the region is very luxuriant. Thence the expedition visited St. Lawrence Island, belonging to the United States, where several Esquimaux were found. Nordenskjöld intended next to explore a portion of Kamtchatka, but abandoned the project, as the wind was unfavorable and there was not much coal left on board. (When released the Vega had eighty tons of fuel and about twelve months' provisions remaining.)

HOSPITALITIES AT BEHRING ISLAND.

The next place touched at was Behring Island, sadly famous for the disastrous death of the distinguished commander whose name it bears. It is now occupied by the Russians, and the American Alaska Trading Company have a valuable station there. By the representatives of each nationality the voyagers were well received and hospitably entertained.

RYTINA STELLARIS.

The professor's special object in going there was to collect the remains of the gigantic animal, the *Rytina stellaris*, now extinct, but alive in the days of Behring. He was successful in finding many bones, enough to constitute several almost perfect skeletons, with which he proposes to endow European museums. At present no specimens are found except in some Russian collections. It was further intended and effected to institute a comparison between the condition of life now actually observable on the island with the lively descriptions of the celebrated and unfortunate Russian savant, Stellar, who wrote upward of one hundred years ago. The American agent supplied the party with fresh meat, giving them a whole cow, and refusing to take any payment.

A SEA BEAR FARM.

The most important industry of the island is the export of the skins of the sea bear (*Otaria ursina*), which animal some years ago bid fair to become as obsolete as the *Rytina*, but is now thriving and multiplying under a wise and beneficent system of protection. On one promontory alone the naturalist saw as many as two hundred thousand of the animals, whose fur is in such great request in American and European cities. From thirty to fifty thousand are slaughtered on Behring and Copper Islands annually, but only at the time when the hair is in the best order. No young or females are allowed to be killed, and otherwise stringent regulations are enforced for the preservation of a valuable species. The result is that their numbers are now augmenting, and they display no fear or anxiety on the approach of men.

AT YOKOHAMA.

From Behring Nordenskjöld came direct to Yokohama, where he arrived on the 2d of September, experiencing no trouble on the passage, with the exception of a severe thunderstorm almost at the termination of the journey. The main-

top was split by lightning, which so pervaded the vessel for an instant that almost all on board felt a distinct shock, as if delivered from a powerful electric battery. As a matter of course and right, the gallant explorer and his train have been fêted and lionized. All sorts of entertainments have been devised in their honor; they have been specially presented to and complimented by the Emperor, and Japanese officials have outdone themselves in the graceful and profuse hospitality which they are so happy to show to distinguished or meritorious strangers.

A PEN SKETCH OF THE EXPLORER.

Nordenskjöld is a man of medium height and robust frame, with hair of the true Viking color, a hale, fair complexion, and a clear, bright eye, whose powers of vision, however, are somewhat dimmed, if wearing spectacles is any criterion. His air and manner are candid and straightforward, and inspire those who meet him with a prompt feeling of admiration and confidence. It is not astonishing that his followers should have the affection for him and trust in his judgment which they openly express and practically evince. As he is several years less than half a century old, he may still aspire to the subjugation of fresh realms in the world of science, and his active brain is still revolving fresh schemes of research, though he might now well rest on the laurels to come to him from his recent great achievement, which must certainly rank with the grandest deeds of this age of discovery and exploit.

COMMERCIAL RESULTS FORESHADOWED.

His opinion upon the navigability of the Siberian Sea and the future result of his labors are as follows: He thinks that the northeast passage between the Atlantic and Pacific oceans may probably be made every year, and will certainly be often repeated. At the same time he holds that trade between the oceans can only indirectly benefit by his discovery. But he thinks that he can effectually demonstrate that there is no difficulty in the way of properly organized trade communication between Yenisei and Europe, and that such commerce can be so conducted that underwriters will as willingly take risks on vessels engaged in it as they are to insure against the accidents of the China Sea. Again, he apprehends no obstacles in the way of experienced navigators yearly plying from the Pacific on one side and the Atlantic on the other to the mouths of the Lena; and then, when the sea is available for intercourse between Lena, Yenisei, and Obi, and the vast oceans, almost all Siberia, and even some parts of North China, will be accessible by water.

THE NEW TRADE.

It is hard to estimate the great benefits which may be expected to accrue. A large and productive trade can be originated, fostered, and developed in a very short space of time to great reciprocal gain and advantage. Those agricultural and other industrial implements which are a *sine qua non* to national prosperity can be introduced cheaply into Siberia and exchanged for raw material which it is too expensive to export overland. Articles of luxury and refinement, which for similar reasons can now only be imported at a price which prohibits their employment by a workingman, can then be imported and become objects of general use. In fine, Nordenskjöld deems that the extent of Siberia, the rich virginity of its soil, and its other natural riches are only comparable to the same conditions in North America one hundred and fifty years ago, and he thinks that the future development of the rich tracts of Asia may equal that attained in the past by the United States.

ITS INTEREST TO THE UNITED STATES.

Especially does it concern the latter country that the prospective and possible communication between the Lena and the Pacific should be looked to, as then the young but vigorous industries of the western districts of the United States would find fresh and practically inexhaustible markets for their productions.

THE ACTION OF NATURE'S FORCES.

PROFESSOR GEIKIE lately delivered two lectures in Boston at the Lowell Institute, upon the action of nature's forces in wearing down the mountains and in changing the configuration of the continents. Chief among these forces are frost, snow, glaciers, rivers, and the ocean. Beginning with the action of the frost, the professor pictured its powerful effects in cleaving solid rocks and throwing down from the tops and sides of cliffs the *débris* which is so frequently seen along their sides. It is in high mountains and high latitudes that the rending effect of the frost is best seen. Vast cliffs have great quantities of matter removed from their sides in the form of small fragments. In the Alps colossal masses of rock have been split off from the mountains by the action of frost. These masses fall upon the glaciers, and every winter adds to the spoil which they bear down. Bowlders are also transported by the ice elsewhere than in glaciers. River ice sometimes takes up rocks which are lying upon the shore and carries them down stream. On the upper sides of the Thousand Isles in the St. Lawrence are many rocks which have been brought down by the ice, and every year it may be seen that they have changed places slightly. All rivers which are liable to be frozen in winter, whose margins have sand and gravel, may suffer loss of material in this way. Snow is another agent which produces geological changes, but it generally acts as a protective agent. Sometimes it acts as an erosive agent, especially in the case of avalanches, either where the snow is perpetual or where it is not. An indirect effect of the action of snow as a geological agent appears in the changes produced by rapid thaws and floods. But by far the most important part played by frozen water is achieved by glaciers. Their action appears best in the Arctic and Antarctic regions and the Alps, and they work both by erosion and by transportation of material. In our own Roxbury ice-worn rocks are frequently found with this peculiar billowy outline characteristic of glacier worn rocks. The glacier markings are liable to be defaced by weather, but when the rock is freshly uncovered the markings appear very distinctly. When the glacier is in motion vast masses of earth are pushed along beneath and in front of it, and great blocks of stone are carried on its surface. We see the surface after it has been left by the ice, but we cannot tell what it was before the ice passed over it. It is probable that the ice found a great deal of *débris* ready at its hand.

To ascertain whether a country has been overrun with ice, we should look for ice-worn rocks. Low lying rocks which have been eroded by glacial action have a rounded billowy form, and rocks higher up, which have never been passed over by the ice, have sharply defined peaks, as they are left by the action of frost. The rocks should be examined to see if they are striated, and, if so, notice should be taken of the direction of the striæ. Loose materials or drift should be sought. It is found disposed in ridges, especially that drift which forms underneath ice. Bowlder clay is arranged in ridges which have much the same direction as the striæ in the rocks found upon and in it. In studying the glaciation of a country it is well to observe how high the bowlders have gone. In North America the surface of the country was probably much the same as now before the glacial period, and this was so, even to the small configurations. The land was probably much covered with detritus. Two great glacial systems are recognized, the eastern and the western. The former extended from Southern Canada westward to the Mississippi, and as far south as Kentucky. It moved from the north or northeast, and was connected with the great Arctic ice sea which moved through Davis' Strait. In Canada the ice-worn rocks are very marked. The Catskill Mountains, also, have been admirably striated, and the markings are very fresh, no rock marks could be more so. A side glacier from the Catskills returned into the parent glacier in the Hudson Valley, and sometimes the markings follow the direction of the main line and sometimes that of the side line, according as one encroached upon the other. These Catskill markings are 2,800 feet above the sea, showing that the ice was about 3,000 feet in the Hudson Valley. The eastern glacial system extended across the country southwest of Lake Superior for several hundred miles. This ice not only polished the rocks but left deposits of clay full of stones. The chief rapids of the St. Lawrence River are caused by deposits of bowlder clay which is so hard and compact that the current does not wear it away. In this eastern glacial system the ice was probably more than 3,000 feet thick in some places.

Very few facts have been gathered about the western sea of ice. It was existing in the Rocky Mountains when the eastern system prevailed. Measurements as to the thickness and size of the glaciers are lacking. Professor Geikie supplied facts about this western system from his own recently gathered information, and mentioned instances of finding mounds of bowlder clay in a valley on the east of the Rocky Mountains, and of finding moraines. The evidence of the ice became more and more striking as he explored. In the second Colorado cañon the sides were completely glaciated from bottom to top. These walls are from 800 to 1,000 feet high, and must have been formed before the glacial period. At the thickest point the glacier was 1,600 or 1,700 feet thick. It is probable that Salt Lake was covered with ice, for the rocks about there show the action of ice. Musk-ox bones are found there, and that was an Arctic animal.

The action of the sea is of two kinds—chemical and mechanical, and its erosive action is less than would be expected. An illustration of the chemical action of the sea was given by a case in which cast iron became so softened that it could be pierced by a penknife. A part of the sea's action is due to hydraulic pressure, which is in some places very heavy. The sea is given an importance far beyond what it deserves as a geological agent. Its action is comparatively insignificant. While the sea would be wearing away a few hundred miles of the coast, the force of the rivers, if it could be constantly at work, would wear away the whole continent.

It is to the mountains, the lecturer said, that we must betake ourselves to learn the plan of the terrestrial architecture. On the great lowlands of the world the superstructure is concealed by deep accumulations of superficial detritus, but among the mountains the whole construction of the earth's rocky coast is laid bare. There, amid all that is grandest and most impressive in nature, the chronicles of the globe must be read. The lecturer referred to the poetry inspired by mountain scenery in all times, and the desire of men to explore the secrets of the hills. He then considered the apparent complexity of mountain structure, and showed wherein the stratified rocks were a clew in unraveling the complexity. From a study of mountain architecture, he continued, we learn that the dry land has been upheaved, at many successive periods, from the sea floor; that these upheavals have taken place generally along the same persistent lines, and that they were separated by prolonged periods of subsidence. After each uplift the new land has been at once exposed to disintegration, and its *débris* has been carried out to the sea bottom, there to accumulate into the thick masses of rock, out of which future lands were to be formed. During the more important movements of upheavals, massive sheets of solid rock have been compressed, crumpled, and even rendered crystalline, and have been squeezed up along lines which have formed mountain chains. Volcanoes, too, have broken out along these lines of terrestrial disturbance, and have poured forth enormous volumes of lava from their heated interior. By revolutions of this nature, often repeated, the framework of the land has been slowly built up. During the long ages of tardy mountain growth, many tribes of plants and animals have come and gone. These reveal the fact that there has been a history and progress of organic life as well as of the solid platform on which this life has been manifested. Generation after generation has passed away; species have changed, even whole types of existence have entirely disappeared, but the records of this progress in the organic world have been preserved within the rocky framework of the land in sufficient fulness to serve as landmarks in geological history. The remains of the extinct ferns and trees, corals and shells, fish and reptiles, entombed within the mountains, become the clew by which the successive dates of the upheaval of these mountains are relatively fixed. They bring before us glimpses of the geography of the long vanished past—here a fair woodland with its lakes and streams; there a sandy shore bounded by bird and reptile; while often amid the rugged landscapes of the heart of a continent they tell us that there of old lay "the stillness of the central sea."

DEVELOPMENT OF THE HOUSE FLY.

By M. H. ROBSON.

THE following remarks on the development of the house fly are based on actual observation, and the appended sketches were made by Mr. G. Harkus from the microscope, with the aid of a Beales reflector.

Mr. Harkus, with whom I experimented simultaneously, was fortunate, or the reverse, in having the required ova brought to him in this way: A fly having gained access to a cold joint of lamb, considerately left a sufficient supply for his examination. The objectionable part of the arrangement was probably counterbalanced by his being enabled to fix the time of deposition with tolerable certainty. This was on July 28. The eggs (one of which is represented in

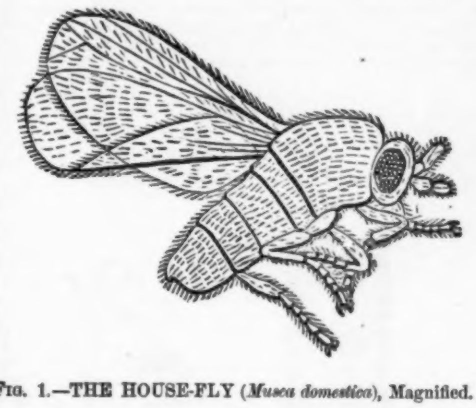


FIG. 1.—THE HOUSE-FLY (*Musca domestica*), Magnified.

Fig. 3, its diameter one thirtieth of an inch) were placed with a portion of the meat in a glass vessel, and next day the maggots had emerged, as in Fig. 4 (diameter one twenty-fifth of an inch), where the ramifications of the tracheal system may be traced.

The warm weather, coupled with the indoor heat, matured the larva rapidly, the change from maggot to chrysalis (Fig. 2) being apparent at each observation, some having assumed this state on July 30. The perfect stage was reached and the fly emerged on August 5, or eight days from the deposition of the ova (Fig. 1).

This was a week in advance of the result obtained in my experiment, which I preferred to conduct out of doors. A piece of raw liver was exposed, which soon had eggs enough attached to it. It would appear that the fly has to some extent the power of withholding the deposition of her ova until a suitable medium is found for the requirements of the larva.

FIG. 2.—CHRYSALIS OF HOUSE-FLY, JULY 30, 1878, × 40.

FIG. 3.—EGG OF HOUSE-FLY, JULY 28, 1878, × 30.

In two or three days the maggots were at work; their activity and voracity in devouring the putrescent mass of animal matter gave it the appearance of fermentation.

For observation in the live box, any little weakness connected with the somewhat objectionable odor arising from the garbage had to be got rid of, and some few maggots washed clean. Neither immersion in water nor yet compression seemed to inconvenience them appreciably; their leathery integument is not easily ruptured, and is sufficiently translucent to render the trachea, as well as the undulatory vermicular movement of the internal organs, apparent throughout under a low power; in fact, from its toughness, transparency, and strength, the larva is an excellent object for microscopic examination. When the animal matter was devoured the maggots moved restlessly about, changing in color from yellowish-white to brownish-red; the cuticle became dense and opaque; motion gradually ceased, until the perfect insect emerged by forcing of the segments of the anterior end of the shell, occupying from fourteen to fifteen days in completing its series of life-changes.

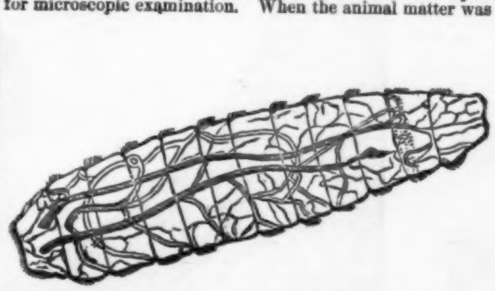


FIG. 4.—MAGGOT OF HOUSE-FLY, JULY 29, 1878, ×25.

Mr. Harkus' part of the experiment appears to be useful so far as to show the adaptability of the fly and its ova to circumstances, and that the larva assumes the chrysalid state when its supply of food becomes exhausted, although otherwise immature (in this case the animal matter given them would dry up), instead of dying from starvation.

The chrysalis and fly in his examples are undersized and impoverished compared to those permitted to feed in a semi-fluid mass of animal matter.

In autumn the house fly seems specially the victim to the

attacks of a parasitic fungus (*Empusa muscæ*), and may be seen glued, as it were, to walls, a white powdery growth appearing at the segments of its body (the spores of the fungus). This vegetable pest is similar to, if not identical with, the parasite which causes so much destruction among fish in aquariums, and last year even attacked salmon in some English rivers.

The cause of the fly becoming so firmly attached to dry surfaces is this: The two pulvilli which, with two strong curved claws (perhaps best seen with the flesh fly, *Musca vomitoria*, as a subject), terminate the foot, are surrounded by a fringe of tubular hairs, each ending with a disk or sucker, through which a glutinous fluid exudes. These form the points of attachment, enabling the insect to walk in any position, the action of the two claws detaching these points as the fly moves along.

When the ravages of the parasite have sufficiently weakened the fly by the destruction of its viscera, etc., it becomes incapable of active movement, and, remaining too long in a place, the viscid fluid continues to exude, and then the fly "sticks to the wall."—*Science Gossip.*

SUGGESTIVE ORNAMENTS FOR DECORATIVE PAINTING.

FIG. 1.—Door head (*Sopra porta*). The ornament shows two tints, one of dark hue (blue, brown, or black) and one of lighter hue, shade of the color of the wall paper, or some other corresponding color.

FIG. 2.—Rosette for a ceiling decoration in imitation of wood work. The inner leafage in shades of inlaid wood or in natural variegated colors on very dark or black ground. Mouldings in wood. The central figure in light wood inlaid on warm blue-gray ground; the border in shades of wood with dark outlines.

FIG. 3.—Ground of flower corresponds to color of wall paper. Ornament painted in three shades of color from yellow to red brown on peacock blue ground. Border a light shade of ground.

FIG. 4.—Ground a light shade corresponding to color of wall paper. Ornament in light, blended colors, edged with dark lines; darkly shaded parts of ornament in the same color as outlines.

FIG. 5.—Flower suitable for both wood and stucco ceiling. Central part in two shades of the color of wall paper, and in another dark, but vivid color. Wreath of ornament in light bright colors edged with dark lines.

FIGS. 6 and 7.—Corner pieces designed for imitation of inlaid wood; may be adapted to colored treatment.

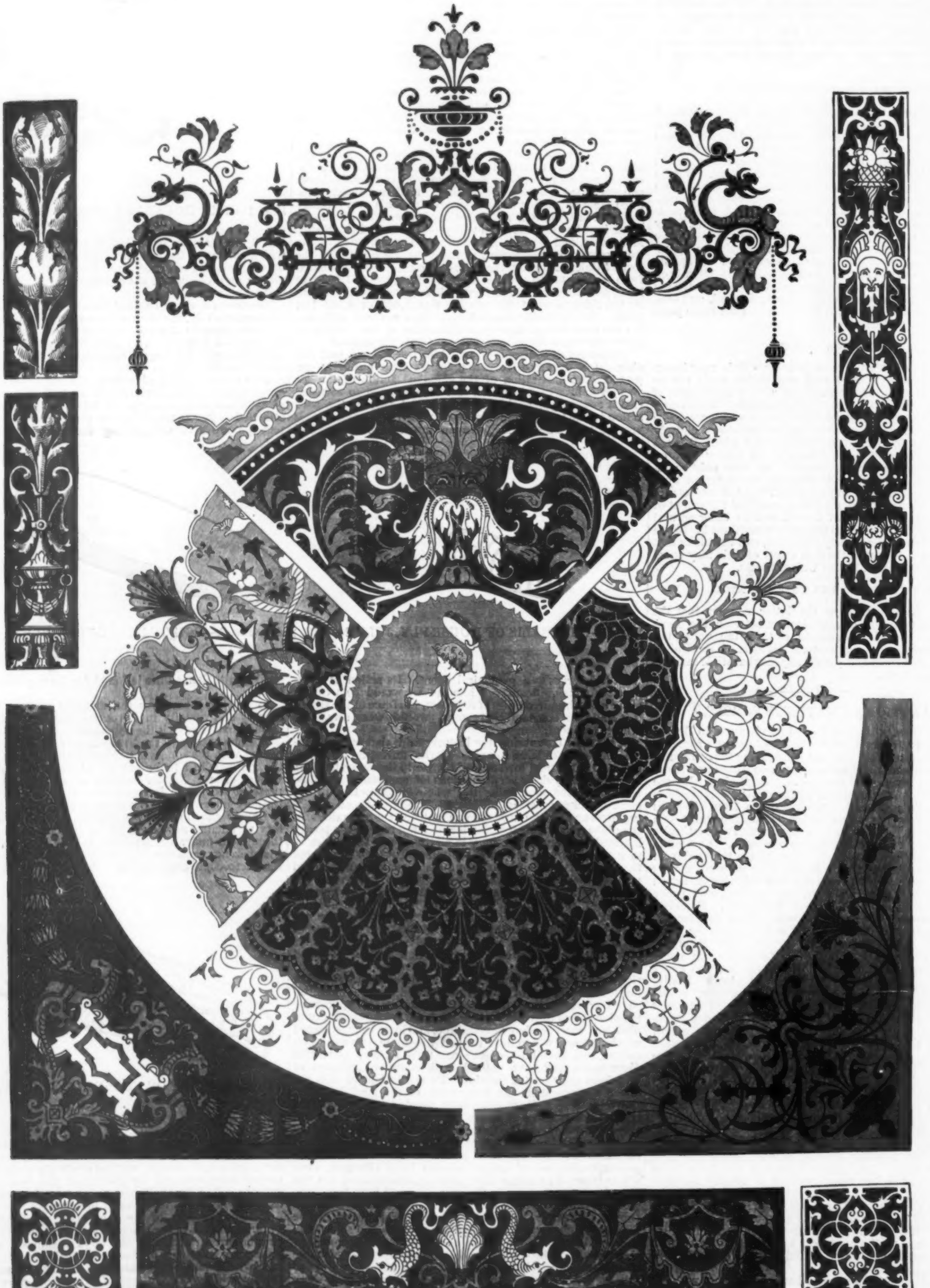
FIGS. 8 and 9.—Rising border and panel ornament, both in different shades of the same color on dark ground.

FIG. 10.—Rising panel ornaments, laid in two tints, edged with dark lines.

FIG. 11.—Frieze ornament for dark colored treatment, or in two shades of the same color on a dark ground.

FIGS. 12 and 13.—Square panel ornaments in marquetry treatment.

In almost all these ornaments intarsia or marquetry treatment was chosen in order to facilitate the execution, which may in the main be effected by stenciling. It is easy to see that these ornaments may be suggestive also for other branches of decorative art.—*The Workshop.*



SUGGESTIONS IN DECORATIVE ART.—ORNAMENTS FOR DECORATIVE PAINTING, DESIGNED BY O. GIRARD, ARCHITECT IN VIENNA.

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